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*Project Health and Safety Plan*

*Appendices*

*June 1996*

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**Barr**  
*Engineering Company*

AR307447

# ***Project Health and Safety Plan***

## ***Appendices***

***June 1996***

**Barr**

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# Project Health and Safety Plan

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Appendix A: Barr Standard Operating Procedures

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## Appendix A: Barr Standard Operating Procedures

### 1.0 Purpose

The Project Health and Safety Plan (PHASP) is aimed specifically at protecting workers from health and safety hazards arising from hazardous substances and/or physical hazards known or suspected to be present at this site. The PHASP includes safety procedures to be followed during anticipated site operations and emergency procedures to be implemented in the event of an injury, fire, accident, or hazardous substance release on site.

The PHASP has been developed based on the guidance contained in the following regulations and guidance documents:

- Occupational Safety and Health Administration (OSHA) Standards, 29 CFR 1910 and 1926.
- U.S. Environmental Protection Agency (USEPA) "Standard Operating Safety Guides," November 1986.
- NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," October 1985.
- Barr Corporate Health and Safety Policy Manual, January 1995.
- American Conference of Governmental Industrial Hygienists (ACGIH); Threshold Limit Values® for Chemical Substances in the Work Environment," 1994-1995.

The PHASP is based upon information available at the time of preparation and is subject to revision or modification as new data and information become available. The revision dates, if applicable, are listed on the title page, and will be included in the next PHASP update.

Specific questions regarding the PHASP should be addressed to the Project Manager or the Project Health and Safety Contact. Questions that cannot be adequately addressed by either the Project Manager or the Project Health and Safety Contact will be referred to the Barr Health and Safety Manager or the Principal in Charge. The PHASP will be reviewed on an approximate annual basis and updated, if necessary, at that time. The PHASP may be modified between annual update periods by amendment. A field copy of the PHASP should remain on-site to be made available to all on-site project personnel and subcontractors.

### 2.0 Applicability

The PHASP applies to all on-site Barr employees and Barr's subcontractors who participate in investigation, remedial action, construction activity, or other field activities. The PHASP provides guidelines, requirements, and procedures intended to help protect the health and safety of all on-site Barr employees and Barr's subcontractors in accordance with the provisions of 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response. The formal adoption procedure of a PHASP is part of the contract documents. Subcontractors should write their own PHASP, and it should include all requirements listed in SECTIONS 1, 2, and 3 of Barr's PHASP, which addresses project health and safety information, emergency action plan, and recordkeeping procedures. The subcontractors PHASP should be reviewed by Barr's health and safety staff. Subcontractors may adopt, in writing, Barr's PHASP, by using the PHASP Adoption Form.

When another party is responsible for site Health and Safety and has prepared a PHASP, when Barr is a subcontractor to another party, or when the site owner has a PHASP, Barr's PHASP should incorporate any requirements more stringent than standard Barr

procedures. Barr will not incorporate less stringent requirements without the approval of the Barr Health and Safety Manager and Principal in Charge.

### 3.0 Site Security and Control

The purpose of site security and site control is to protect the public from a site's chemical and physical hazards and to limit access to the site by the general public and unauthorized persons when necessary. The site perimeter may be delineated by an existing fence line, boundary markings, or through the use of a security patrol. Individual site work zones may be delineated within this boundary. If necessary, signs may be posted to prevent unauthorized entry onto the site. Specific site control measures are described in SECTION 1: PROJECT HEALTH AND SAFETY INFORMATION of the PHASP.

### 4.0 Hazard Groups

#### 4.1 Hazard Group Analysis for Project Tasks

A Hazard Group analysis assesses the hazards associated with a particular task on a project site and matches that task to a Hazard Group. There are five hazard groups, and each has been described in Table A-1, Hazard Group Description. Each hazard group represents a different potential for exposure and consequently has been assigned a corresponding level of personal protective equipment (PPE).

The Hazard Groups are differentiated by anticipated concentrations of hazardous substances which may be encountered during work activities. "Low", "medium" and "high" classifications differentiate Hazard Groups 2, 3 and 4. A qualitative description of these concentrations of hazardous substances follows:

- "Low" = No pure-phase product containing a hazardous substance expected in either groundwater or soils. Work activity may require some contact, principally walking over soil or contacting soil or groundwater known or suspected to contain hazardous substances with the hands. Previous evaluation of site work has determined that skin contact does not present a significant exposure pathway. The primary purpose of PPE is to prevent hand to mouth contaminant transfer.
- "Moderate" = Pure-phase product containing a hazardous substance may be present. Work activity involves handling contaminated soils or groundwater but contact with the torso is expected to be minimal (i.e. prolonged or frequent body contact is not expected and no splash potential exists).
- "High" = Pure-phase product containing a hazardous substance is known to be present during work activity and the potential for whole-body contact ranges from possible to unavoidable (i.e. prolonged or frequent body contact is expected and/or splash potential exists).

Table A-1

## Hazard Group Description

Hazard Group	Description
Group 0	No contact with hazardous substances is expected during this work activity. No construction hazards are immediately adjacent to the work area while this work activity is being performed. No specific level of protection is required except for normal work/street clothes.
Group 1 (Level D1)	No contact with hazardous substances is expected during this work activity. Construction hazards are immediately adjacent to the work area while this work activity is being performed. Level D1 protection would be appropriate.
Group 2 (Level D2)	Contact with "low" levels of hazardous substances is expected during this work activity. Construction hazards are immediately adjacent to the work area while this work activity is being performed. Level D2 protection would be appropriate.
Group 3 (Level C3/D3)	Contact with "moderate" levels of hazardous substances is expected during this work activity. Construction hazards are immediately adjacent to the work area while this work activity is being performed. Level D3 protection would be appropriate. Possible upgrade to a corresponding Level C protection.
Group 4 (Level C4/D4)	Contact with "high" levels of hazardous substances are expected during this work activity or contact with contaminated liquids is possible. Construction hazards are immediately adjacent to the work area while this work activity is being performed. Level D4 protection would be appropriate. Possible upgrade to a corresponding Level C protection.

Typical Barr work activities have been evaluated for their inherent hazards and have been assigned to a particular hazard group. Work activities assigned to the same hazard group have similar exposure potentials, even if the activities are different. In this way, the work activity and its exposure potential prescribes the personal protective level and air monitoring needs in conjunction with the type of site where a work activity is performed.

For example, a nonintrusive activity such as surveying in a field on a former coal tar site which is covered with asphalt may fall into a Hazard Group 1 requiring Level D1 personal protection while an intrusive activity on that same site may fall into a Hazard Group 3 requiring Level D3 personal protection because of the increased potential for exposure from that intrusive work activity. Levels of protection are described in APPENDIX C - PERSONAL PROTECTIVE EQUIPMENT (PPE) PROGRAM.

If, during the course of conducting activities in Group 0 or Group 1, the following are encountered: (1) the detection of odors from exposed soils/fluids; (2) appearance of oiliness in soils; or (3) unnatural soil discoloration, activities should be suspended. The Barr Project Health and Safety Team Leader will reassess field conditions with regard to hazard groups and personal protective levels, choose appropriate modifications, and field personnel will implement the modifications before resuming the Work.

TABLE A-2: TYPES OF WORK ACTIVITIES IN HAZARD GROUPS lists typical work activities performed by Barr personnel and shows the different types of Hazard Groups in which an activity may be classified. The potentially applicable hazard groups are marked with an "X". Actual site specific conditions may require a different level of personal protective equipment than that noted. Site specific levels of personal protective equipment are described in SECTION 1 of the PHASP.

Table A-2

Examples of Common Work Activities Classified in Hazard Groups<sup>(1)</sup>

Work Activity (Personal Protection Level)	Group 0 (Street Clothes)	Group 1 (Level D1)	Group 2 (Level D2)	Group 3 (Level D3)	Group 4 (Level D4)
Reconnaissance	X	X	X	X	X
Geophysical survey	X	X	X	X	-
Geotechnical soil boring	-	X	-	-	-
Surface water level measurement	X	X	X	-	-
Surface water sampling	X	X	X	-	-
Groundwater level measurement	X	X	X	X	-
Construction observation <sup>(2)</sup>	-	X	X	-	-
Site remediation construction observation	-	X	X	X	X
Observation of soil boring advancement	-	X	X	X	X
Observation of monitoring well installation	-	X	X	X	X
Observation of piezometer installation	-	X	X	X	X
Soil gas survey	-	X	X	X	-
Groundwater sampling	X	X	X	X	X
Free product sampling	-	-	-	X	X
Monitoring well slug testing	X	X	X	X	X
Monitoring well development	-	X	X	X	X
Monitoring well pump test	X	X	X	X	X
Observation of test trenching	-	-	X	X	X
Collection of surface soil samples	X	X	X	X	-
Collection of soil samples from borehole	-	X	X	X	X
Collection of soil samples from backhoe bucket	-	X	X	X	X
Collection of waste/sludge samples	-	-	-	-	X
Observation of slurry wall construction	-	X	X	X	X
Observation of soil treatment activities	-	-	X	X	X
Performance of jar headspace screening	-	-	X	X	X
Industrial stack sampling	-	X	X	X	-

<sup>(1)</sup> Site specific conditions may require a higher level of protection.

<sup>(2)</sup> Construction observation includes observing the following activities: site grading, construction of leachate collection system, installation of drainage system, cap construction, liner construction, etc.

X = Activity may be performed in this Hazard Group.

- = Activity is not expected to be performed in this Hazard Group.

## 5.0 On-Site Work Zones

On-site control minimizes potential contamination to other site areas and facilitates safe work activities. Site control methods include the designation of site work zones at the project site, and decontamination of field personnel and equipment.

Five work zones may be established on a site: the hot zone, the exclusion zone, the contamination reduction zone (DECON), the work area, and the support zone. On a complex site all five work zones may be established. On a simple site there may only be three work zones (exclusion zone, DECON zone, and support zone). On a site involving activities which do not involve hazardous substances, there may only be one work zone (work area).

These zones may be defined by physical or visual segregation of work activities. Barrier tape, spray painted lines, traffic cones or other physical markers will be used to delineate a work zone area if it is unclear.

These five work zones are defined as follows:

### 5.1 Hot Zone

A hot zone is contained within the exclusion zone (see 5.2 below) and is an area where hazardous substances are known to be present and a high potential for exposure exists. A hot zone is used to delineate test trenching and contaminated soil excavation activities. Work activities in a hot zone usually are designated as Hazard Group 4.

### 5.2 Exclusion Zone

An exclusion zone is defined as the area where hazardous substances are expected to be present, or where selected physical hazards may be present because of site activities. All personnel entering the exclusion zone must wear the appropriate protective equipment and comply with appropriate procedures to work in that zone. The purpose of an exclusion zone is to control access into an area where hazardous substances are present and to minimize cross-contamination to the noncontaminated portions of the site.

An exclusion zone designation is required when any of the following conditions exist:

- The site activity is a cleanup operation on a hazardous waste site.
- The site activity is an initial investigation at a government identified site before the presence or absence of hazardous substances has been ascertained and there is a reasonable possibility for exposure.
- hazardous substances are present at the ground surface.
- An intrusive activity will be conducted and there is a possibility for exposure through skin absorption or irritation, or eye irritation.
- An intrusive activity will be conducted and there may be a possibility for exposure which may exceed a work place exposure standard or IDLH concentrations.
- An intrusive activity will be conducted and there may be a possibility for fire or explosion.

### 5.3 Contamination Reduction (DECON) Zone

A contamination reduction (DECON) zone is the area which all Barr employees and Barr's subcontractors must pass through to enter or exit an exclusion zone. A DECON zone is an area suspected to be clean (uncontaminated). It is located adjacent to an exclusion

zone as a buffer between: (1) the area where hazardous substances are known or suspected to be present; and (2) the area known suspected to be clean. Personnel and monitoring equipment decontamination activities occur in this zone.

Supplemental personal protective equipment (such as surgical gloves, chemical apron, face shield, etc.) may be required for the performance of selected tasks in this zone. Sample handling and examination and the packing of sample containers into transporting containers, where the only potential for cross-contamination is from the sample container, may occur in a DECON zone. Decontamination of heavy equipment (e.g. drill rigs and drain hole equipment, backhoes, etc.) should be conducted in this zone.

#### **5.4 Work Area**

The work area is that portion of a site where work activities are being performed, and where no hazardous substances are expected to be encountered. The work area is generally not included in another designated zone (i.e., hot zones, exclusion zones, DECON zones, or support zones). The purpose of a work area is to control access due to physical hazards. Basic safety equipment such as hard hat, steel-toed work boots/insulated steel-toed boots, and safety glasses (Level D1) are required in the work area unless otherwise specified in the PHASP. Portions of the work area may be subject to the provisions and requirements of safety plans or health and safety plans of other employers performing activities in the work area.

#### **5.5 Support Zone**

A support zone is located in an area that is not known or expected to contain hazardous substances. The physical hazards that are common to the site are generally not present. Support materials (clean protective equipment, supplies, etc.) will generally be located in this zone. Personal use articles, such as vehicles, telephones, office trailers, and sanitation facilities can be located in this zone. Basic personal safety equipment (hard hat, steel-toed work boots/insulated steel-toed boots, and safety glasses) are generally not required in this zone.

A support zone may be established at a site based on the following considerations:

- The support zone area is not suspected to be contaminated.
- The location of a contamination reduction (DECON) zone is adjacent to support zone.
- The availability of services or ability to provide services, such as electric power, telephone, water, roads, etc. are convenient to the support zone.
- The support zone is upwind of site activities.

Eating, drinking, and smoking may be permitted in selected portions of a support zone or a work area.

#### **6.0 Buddy System**

The buddy system is a system whereby each member of a project field team has a specific agreement with at least one other member of the field team to mutually maintain line-of-site communication and provide rapid assistance in the event of an emergency.

Entry into the exclusion zone or hot zone requires implementation of the buddy system. The only work zones that do not require the use of the buddy system are the DECON zone, the work area, and the support zone.

To properly utilize the buddy system, all applicable Barr employees and Barr's subcontractors are assigned at least one buddy while working in the exclusion zone or hot zone. When it is not feasible for two Barr employees to act as each others buddy, the buddy may be a client (owner's representative), an assigned employee of Barr's subcontractor, an assigned employee of the owner's contractor, preferably but not necessarily a safety trained (24 or 40 hours hazardous waste training) person on site, as long as both buddies agree to act as each other's buddy prior to entry to the exclusion or hot zones. Buddies must remain in each other's line-of-sight at all times unless both buddies are in possession of operating walkie-talkies. Barr's subcontractor will be required to provide a buddy whenever necessary when a Barr employee is working in the exclusion or hot zones.

A buddy is not required within the same exclusion or hot zone, as long as (1) communication equipment (such as walkie-talkies) or line-of-sight are used and (2) the buddy can render emergency care if needed. This requires that the buddy be prepared (wearing proper personal protective attire) to promptly enter the exclusion/hot zone to render emergency care if necessary.

## 7.0 Site Communications

Successful communications between personnel is essential. There are two types of communications systems: normal operating communications and emergency communications. The following normal operating communications systems may be available for on-site activities:

- normal, direct verbal communication
- walkie-talkies
- whistle
- hand signals (TABLE A-3: NONVERBAL COMMUNICATION SYSTEM)
- portable phone
- land-line phone

Project specific emergency communications are described in SECTION 2: EMERGENCY ACTION PLAN/EMERGENCY PHONE NUMBERS of the PHASP.

TABLE A-3: NONVERBAL COMMUNICATION SYSTEM describes the hand signals that may be used to communicate while on site.

Table A-3

### Nonverbal Communication System

Hand Signal	Definition
Thumbs up	OK/I am alright/I understand
Thumbs down	No/negative
Finger across the neck	Shut down equipment/Stop activity
Hands on top of head	Need assistance
Hands clutching throat	Out of air/cannot breath
Arms waving upright	Send backup support
Grip partner's wrist	Exit area immediately



## 8.0 Safe Work Practices

The following safe work practices should be followed by all Barr employees and Barr's subcontractors during regular (nonemergency) site work.

### 8.1 Personal Precautions

Personal precautions for work on-site are described below:

- Use appropriate personal protective equipment (hard hat, steel-toed boots, safety glasses, etc.).
- Limit on-site work to daylight hours unless area lighting is provided.
- Hands and face must be thoroughly washed before eating/drinking or using tobacco products.
- Facial hair shall not interfere with proper respirator fit.
- Be aware that some prescribed drugs may potentiate the effects from exposure to moderately hazardous substances, may interfere with the safe performance of a work activity, or may interfere with tolerance to temperature extremes.
- Refrain from wearing rings, necklaces, bracelets, or earrings when conducting a work activity.
- Be aware that off-hour use of alcohol or caffeine may cause dehydration and affect endurance during temperature extremes.
- Be aware that lack of adequate rest during off-hours may interfere with alertness to potential hazards.

### 8.2 Standard Operating Practices for Work On Site

Standard operating practices for work on site, within the hot zone, exclusion zone, or DECON zone are described below:

- No smoking, eating, drinking, or chewing tobacco or gum.
- No matches, lighters, or torches, unless specifically addressed in specifications as a necessary component of site activities.
- Buddy system implemented when working in the exclusion zone or hot zone with line-of-sight with buddy maintained unless both buddies are in possession of operating walkie talkies, which are effective for the range used.
- Normal communications system implemented.
- Refrain from wearing rings, necklaces, bracelets, or earrings around any machinery.
- Appropriate level of personal protection worn.
- Perform air monitoring as specified in PHASP.
- Safety information documentation as specified in PHASP.

## 9.0 Identification of Key Personnel On Site and Responsibilities

Barr has designated safety responsibilities to various project team members. These responsibilities are given to the Company Safety Officer, Principal in Charge, Company Health & Safety Manager, Project Manager, Project Health and Safety Contact, Barr Project Health and Safety Team Leader, and Barr's on-site representative. Barr's subcontractors have designated safety responsibilities for this project to various members of the subcontractor's staff. These responsibilities are described below:

- **Company Safety Officer:** The Company Safety Officer is the person designated by Barr to have corporate responsibility for the safety of Barr employees.

- **Principal in Charge:** The Principal in Charge is the person designated by Barr to have corporate responsibility for the project and responsibility for employee safety on the project. Responsibilities include contracting/negotiating work scope, scheduling, budgeting, and billing. The Project Manager will report to the Principal in Charge as necessary.
- **Company Health and Safety Manager:** The Company Health and Safety Manager is the person designated by Barr to administer the Health and Safety Program.
- **Project Manager:** The Project Manager is the person designated by the Principal in Charge to have day-to-day safety and management responsibility for a given project.
- **Project Health and Safety Contact:** The Project Health and Safety Contact is responsible for providing guidance for implementing the PHASP.
- **Barr Project Health and Safety Team Leader:** The Barr Project Health and Safety Team Leader is designated by the project manager and is responsible for implementing safety procedures on the project site. This person will be identified in the PHASP. If not designated, the safety trained Barr employee on the project site with the most experience working at Barr will assume the role on the project site. The Project Health and Safety Team Leader reports to the Project Manager.
- **Barr Resident Project Representative:** The Barr On-site representative is the person responsible for on-site observation of the project along with implementation of the plans and specifications. This person may also act as the Barr Health and Safety Team Leader.
- **Subcontractor:** The subcontractor is the person designated by the subcontracting firm to have corporate responsibility for the project. Responsibilities include subcontracting with Barr, scheduling, budgeting, and billing/collecting. The subcontractor's representatives will report to the subcontractor as necessary.
- **Subcontractor's Site Safety Officer:** The Subcontractor's Site Safety Officer is the person responsible for implementing safety procedures on the project verifying that procedures are followed by subcontractor's employees, and is designated by the subcontractor. The Subcontractor's Site Safety Officer will be on-site while the subcontractor's work is in progress.
- **Subcontractor's Representative:** The Subcontractor's Representative is the person designated by the subcontractor to have responsibility for on-site implementation of the subcontractor's work. This person is designated by the subcontractor, and may also act as the Subcontractor's Health and Safety Team Leader.

A detailed list of responsibilities for the Project Manager, Project Health and Safety Contact, and the Barr Project Health and Safety Team Leader are available in the January 1995 edition of the Barr Health and Safety Manual.

## 10.0 Project Health and Safety Plan Updates and Reviews

Updates and amendments to the PHASP will be made as required by changes in Barr policy, requirements of law and regulations, changes in site activities, site conditions, or when additional information becomes available. The effectiveness of the PHASP may be evaluated by the Project Health and Safety Contact or other industrial hygienists at Barr during the course of the project or upon completion of field work. This evaluation is usually conducted by interviewing members of the project team to evaluate the effectiveness of the PHASP. In addition, all Barr PHASPs at active project sites will be reviewed on an approximate annual basis and, if necessary, updated to reflect the appropriate changes.

An on site review/audit may be completed using the Barr Project Health and Safety Plan Audit Checklist and/or the EPA Health and Safety Audit Guidelines. The results of this audit will be communicated verbally or in a written memorandum to the project team members, including the Project Manager and the Principal in Charge. The audit results will also be noted in the project safety file.

## 11.0 Visitors to the Site

The following guidelines were developed to assist field staff when dealing with visitors to Barr sites. A visitor is typically defined as a person with legitimate reasons for access to the site where it can be demonstrated that access does not involve exposure or the reasonable possibility for exposure to health and safety hazards. However, a visitor may also need to access portions of the site which may involve exposure or the reasonable possibility for exposure to health and safety hazards. In those cases, Section 11.1.2 will also apply.

### 11.1 Sites Controlled by Barr

Determine who the visitor is, and their affiliation (agency, client, PRP, media, general public, etc.). Find out what they need to see, and whether they can accomplish their task from outside our work zones (decontamination and exclusion zone). Record this information in the project field diary, or project safety diary.

#### 11.1.1 Visitors to the site may include:

- **General Public, Media:** If the site, including the support zone is fenced, the Barr Health & Safety Team Leader should keep members of the press or general public outside the fence, unless the project manager or principal in charge gives permission for them to access the site. If the site is unfenced, members of the general public may be allowed in our support zone only; however, those parties should be asked to stand well back from any heavy equipment or other operations. The more clearly work zones are marked, the easier it is to keep the general public out of those areas. The project manager should be informed promptly of any visits by members of the general public or press.
- **Regulatory Agencies:** Unless their visits have been previously arranged, regulatory agency personnel should be asked to wait in the support zone, while the Barr Health and Safety Team Leader contacts the project manager, principal in charge, or, if they are not available, any available Company principal. The project manager or principal in charge will advise the field project personnel how to proceed. While waiting for a response from project management, make the person from the regulatory agency comfortable. If available, invite the visitor into the Barr trailer or other office on-site.
- **Other Parties Needing to Access the Site:** If other parties request access to the site, this request should first be discussed with the project manager. They should not be allowed in to work zones other than the support zone without first presenting training documentation.

#### 11.1.2 Visitors that need to access portions of the site other than the support zone will be required to provide the following documentation.

- **Training Documentation:** Persons wishing to access work zones other than the support zone should present evidence that they have completed the following training:

40-hour Hazardous Waste Training  
8-hour Annual Refresher Training (current)

In some circumstances a lesser amount of training, such as 24-hour training, may be acceptable. This should be decided by the project manager with advice from the health and safety staff.

- **Medical Documentation:** Generally, persons wishing to access work zones other than the support zone must present documentation that they have been examined by a physician, and that the physician has cleared them for work on a hazardous waste site. If the person may be required to wear a respirator, the documentation should also include a physician's clearance to wear a respirator.

Exceptions to the medical documentation requirement may be made by the project manager, with advice from the health and safety staff. Exceptions may be made in the case of short duration (1-2 days) visits, where exposure would be minimal, and the visitor would not be required to wear respiratory protection.

**11.1.3 Barr's Responsibility for Visitors**

By admitting visitors to the work area, Barr accepts a measure of responsibility for the visitors' safety. While Barr does not generally supply visitors with protective clothing unless prior arrangements have been made, the project health and safety team leader should make sure that the visitor is wearing clothing appropriate to the site conditions, in accordance with the project health and safety plan.

All visitors should be briefed on the potential hazards, site safety requirements, and emergency procedures. The visitor should be asked to sign a site log-in sheet.

Under no circumstances should visitors be allowed to wander around a site unescorted. Ideally, a Barr escort should be provided for the visitor. If there are not sufficient Barr staff to do this, then, at a minimum, the visitor should be kept in verbal and visual communication range.

**11.1.4 Unauthorized/Uncooperative Visitors**

The primary concern of Barr personnel on any site must be their health and safety. Personnel should exercise their best judgement when dealing with uncooperative or unauthorized visitors. While Barr personnel may politely ask or instruct someone not to enter the site, they should never attempt to physically restrain a visitor, nor should they be drawn into an argument. If unauthorized personnel disregard Barr's request not to enter the site, project personnel should immediately shut down site operations and contact the project manager or principal in charge. Similarly, if visitors allowed on site refuse to follow the site rules, they should be politely asked to leave the site. If they do not leave the site, operations should be immediately shut down and the project manager or principal in charge notified as soon as possible.

If, at any time, Barr employees or Barr's subcontractors feel their safety is jeopardized by a visitor, leave the area, if possible, and contact the police. After Barr employees have assured themselves of their safety, then they should contact the project manager or principal in charge.

**11.2 Sites Not Controlled by Barr**

When Barr is on a site as a technical observer of site work, with no direct responsibility for management of the site, Barr's responsibility regarding visitors is limited. Barr employees should record the visit in the project safety diary, and attempt to find out the purpose of the visit. In the case of visits from regulatory agencies, the media, or other parties, which could impact our client, the project manager or principal in charge should be promptly notified.

Do not attempt to screen the visitor, deny or permit them access, or take responsibility for their safety on the site. In addition, note whether the party controlling the site has taken the appropriate precautions.

**12.0 OSHA Inspections**

The following procedures discuss Barr's response to OSHA inspections when: 1) Barr is prime contractor, or 2) when another party including the owner serves as prime contractor.

## 12.1 Procedures to be Followed when Barr is Prime Contractor

The procedures listed below are to be followed in the event that an OSHA inspector visits the site, and Barr is the prime contractor. The procedures are consistent with Barr's rights and the requirements for OSHA's performance of an inspection.

- a) Introduce yourself with your name and title. Titles to choose from include field geologist, field engineer, field observer, resident project representative, Barr Project Health and Safety Team Leader, etc. In these first minutes of orientation, try to ask all the questions. Hold off answering any additional questions until you have contacted the Project Manager (see below). If there is more than one Barr employee on-site, the most senior Barr employee should act as Barr's on-site representative until the Project Manager is contacted.
- b) Ask the OSHA inspector to show you their credentials. Inspect the credentials; the credentials should have a picture of the OSHA inspector. If necessary, ask for the phone number of the OSHA inspector's office to confirm that this is an OSHA inspector.
- c) Ask the OSHA inspector for certification of 40 hour training, and the most recent 8 hour refresher. The OSHA inspector **may not** enter the hot zone, exclusion zone, or DECON area (according to 1910.120) without this training. In addition, the OSHA inspector is required to have the appropriate PPE, as specified in the PHASP for work zone entry, and the OSHA inspector **may not** enter those work zones without the appropriate PPE. Certification of participation in a medical surveillance program may be optional for OSHA inspectors, if they don't routinely work on hazardous waste sites.
- d) Ask the OSHA inspector what is the purpose of their site visit.
  - What type of inspection is this? Complaint? Follow-up? General Schedule?
  - What are the areas of the site that the inspector has come to the site to inspect?
  - If there was a complaint, ask to see a written copy of the complaint.
  - What type of monitoring, if any, does the inspector expect to conduct?
  - If the site is more than a one-hour drive/air flight from Barr's office, ask the OSHA inspector if they would come back tomorrow to talk to the Project Manager.
- e) Inform the OSHA inspector that you will need to contact the Project Manager since you do not have the authority to either grant or limit the inspection. If Barr is the prime contractor, ask the OSHA inspector to wait off-site and not to take any pictures while you are making this phone call. If Barr is not the prime contractor, see paragraph 12.2 below.
- f) Call the Project Manager and indicate what you have learned about this OSHA inspection. You have the right to make this phone call in private.
 

Since Barr is the prime contractor, the Project Manager should tell you to ask the OSHA inspector to wait off-site, until the Principal in Charge arrives. Until that time, inform the OSHA inspector that you cannot give the inspector permission to begin the inspection, take any pictures or interview Barr employees. Such permission can only be granted by the Principal in Charge.
- g) The Project Manager should in turn try to locate the Principal in Charge, other designated Principal, Allan Gebhard, Larry Molsather, John Dickson, or Karen Stoller to discuss what Barr's response to this inspection will be. Additionally, the Project Manager will inform the site owner and if different, our client.
- h) Generally, if the site is within a one hour drive or air flight from the office, inform the OSHA inspector that the Principal in Charge is on their way to the site. This is a **reasonable** time period for the OSHA inspector to wait, and ask the OSHA inspector to wait off-site. Do not talk unnecessarily to the OSHA inspector until the Principal in Charge arrives.
- i) If the OSHA inspector will not wait for the arrival of the Principal in Charge, call the Project Manager again and explain the predicament. A conference call should be set up at this time for the Opening Conference. The Opening Conference is the first stage of an OSHA inspection.
- j) Sooner or later the OSHA inspector will perform their inspection. Continue site operations so that OSHA inspector may observe health and safety procedures. It is not necessary to shut-down operations, however, all site personnel should be informed that an OSHA inspection is in progress. Operations may be shut down if participation in the inspection impedes the progress of the project work. If the OSHA inspector performs air monitoring, be sure to conduct air monitoring side-by-side with the OSHA inspector.
- k) Be courteous, answer the OSHA inspector's questions, and take careful notes.

**12.2 Procedures to be Followed When Other Parties Are Prime Contractor**

If another party has responsibility for site control such as the owner or the owner's or client's contractor and they have granted access to the OSHA inspector to conduct the inspection of their employees, call the Project Manager and explain that the inspection is in process. The guidelines listed above (a through k) still generally apply. The exceptions are that since site control concerns are the responsibility of the prime contractor, we may not be able to ask the OSHA inspector to wait off-site or deny entry to the site if they do not have appropriate training documentation. There are usually several concurrent inspections conducted by OSHA on a construction site. The OSHA inspector should be asked to wait before starting the inspection of Barr's activities until the Principal in Charge determines the appropriate course of action.

*B/ Hazard Evaluation*

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## Appendix B: Hazard Evaluation

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## Appendix B: Hazard Evaluation

## 1.0 Safety and Health Risk Analysis for Project Tasks

TABLE B-1: SAFETY AND HEALTH RISK ANALYSIS FOR PROJECT TASKS describes potential safety and health risks which may be encountered by Barr employees while performing the following project tasks. Other physical hazards are discussed in subsequent sections of this Appendix B.

Table B-1

Safety and Health Risk Analysis for Project Tasks

Task	Task Description	Chemical Hazards	Physical Hazards
Reconnaissance	Walk around site, nonintrusive investigation Observe or measure topography; stake line and grade for construction	Potential for skin and inhalation exposure to soil which is known or suspected to contain hazardous substances	Slip, trip, or fall hazards
Observation of Remedial Construction, Observation of Other Construction Activities, and Observation of Excavation/stockpiling of soils	Observe: • Site grading, cap and liner construction • Drain installation • Various other heavy construction in contaminated and clean areas	Potential for skin exposure to soil which is known or suspected to contain hazardous substances and inhalation exposure to dust and soil gas which is known or suspected to contain hazardous substances	Heavy equipment operations, excavation cave-ins, equipment operational hazards, overhead, and underground utilities, slip, trip, or fall hazards
Observation of Intrusive Site Investigations/Test Trenching	Direct and/or Observe: • Soil boring advancement • Monitoring well installation • Test trenching	Potential for skin exposure to soil which is known or suspected to contain hazardous substances and inhalation exposure to dust and soil gas which is known or suspected to contain hazardous substances	Equipment operation hazards, sidewall cave-ins, slip, trip, or fall hazards, high noise levels, overhead and underground utilities
Nonintrusive Geophysical Survey	Perform electromagnetic, seismic, gravimetric, or other geophysical survey	Potential for skin exposure to soil which is known or suspected to contain hazardous substances	Lifting hazards, slip, trip, or fall hazards, low level electromagnetic radiation exposure
Soil Gas Survey	Collect soil gas with soil probe; or perform analysis	Potential for skin exposure to soil which is known or suspected to contain hazardous substances and inhalation exposure to soil gas which is known or suspected to contain hazardous substances	Underground utilities, unknown obstructions, slip, trip, or fall hazards, pinch point hazards
Water Sample Collection	Collect water samples from surface water and monitoring wells; or measure water levels	Potential for skin exposure to water which is known or suspected to contain hazardous substances and inhalation exposure to volatiles in water	Lifting hazards, slip, trip, or fall hazards, bee hives in casings, water hazards, pinch point hazards
Waste or Sludge Sample Collection	Collect waste or sludge material from waste or sludge lagoon/pit	Potential for skin exposure to concentrated waste or sludge and inhalation exposure to waste or sludge vapor which is known or suspected to contain hazardous substances	Slip, trip, or fall hazards

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Task	Task Description	Chemical Hazards	Physical Hazards
Soil Sample Collection	Collect and classify soil samples from surface soil, soil borings and/or trench soils; perform headspace screening	Potential for skin exposure to soil which is known or suspected to contain hazardous substances and inhalation exposure to soil gas and dust which is known or suspected to contain hazardous substances	Equipment operational hazards, slip, trip, or fall hazards
Aquifer Testing	Slug test; pumping test; monitoring well development	Potential for skin exposure to water which is known or suspected to contain hazardous substances and inhalation exposure to volatiles in water	Slip, trip, or fall hazards, lifting hazards, bee hives in casing, pinch point hazards, dismemberment

## 2.0 Chemical Hazards

Site operations may involve handling materials which are known or suspected to contain hazardous substances. Exposure to these materials may occur through one or more of the following routes.

### 2.1 Inhalation

Substances that primarily pose an inhalation hazard are those that volatilize easily at ambient temperatures (20-25°C). A rule of thumb is that substances with vapor pressures greater than that of naphthalene (0.08 mm Hg) at ambient temperatures may be considered volatile. Inhalation hazards may exist when particulates containing hazardous substances become airborne.

### 2.2 Skin/Eye Contact

Some hazardous substances may be absorbed through the skin and be transported to the bloodstream. Many other substances are not absorbed but react with the skin surface causing irritation or burns. Absorption occurs most readily through open wounds, inflamed skin, or through eye contact. Hazardous substances noted with the "skin" notation in TABLE 5-2 (SECTION 5: TOXICITY PROFILE of the PHASP) are known to be absorbed through the skin.

### 2.3 Ingestion

Ingestion may occur through eating or smoking with hand to mouth contaminant transfer. Incidental ingestion of particulates containing hazardous substances may also occur under dusty conditions generated in areas known or suspected to contain hazardous substances.

### 2.4 Injection

Exposure may occur if a hazardous substance is injected into the skin through skin puncture or cut by a foreign object such as spikes, metal edges, wood splinters, etc.

### 3.0 Safety Procedures for Physical Hazards

Site operations and tasks may involve inherent physical safety hazards. The safety procedures for these hazards are described in the following paragraphs. Site-specific hazards may be discussed in SECTION 1: PROJECT HEALTH AND SAFETY INFORMATION of the PHASP.

#### 3.1 Utilities

Overhead and underground utilities (e.g., electric, gas, telephone, water, sewer, drainage, etc.) and associated pipes in the project work areas must be located. Underground utilities should be located and marked by the utility owners or site owners before the start of any intrusive activity. Overhead utilities should be located and where appropriate, protected before the set-up and operation of heavy equipment, such as a drill rigs, cranes, loaders, manlifts, etc.

#### 3.2 Heavy Equipment Operations

Site operations may involve the use of heavy equipment such as drill rigs, backhoes, dozers, loaders, scrapers, trucks, etc. by Barr's subcontractors or the site owner's contractors. The following information describes additional safety procedures while working around heavy equipment.

- a) Stay within the line-of-sight of the operator at all times while working near the equipment. Normal operation of heavy equipment affects the operator's ability to hear and to see all areas around the equipment.
- b) Keep a safe observation distance of at least the reach of the backhoe bucket plus 5 feet except when working directly with the backhoe operator. If working within reach of operating equipment always alert operator of your position.
- c) Avoid walking directly in back or to the side of heavy equipment. Avoid operator blind areas. Understand the direction the equipment is likely to move and how quickly it may make the maneuver.
- d) Verify that underground and overhead utilities have been identified and located.
- e) Be aware of footing and surroundings at all times.
- f) Do **not** work near equipment that may appear obviously unsafe because of deterioration, missing parts, obvious defects, or improper operation. Do not permit use of such equipment by any of Barr's subcontractors if equipment appears to be unsafe.
- g) If heavy equipment and other vehicles share a common roadway, Barr employees and Barr's subcontractors should be alert to this traffic and yield right-of-way. If working in an area with congested heavy equipment operations, wear an orange vest. Park in a clear area, not in an area obstructed from operator's view.
- h) Do not operate heavy equipment.
- i) Stay out of reach of cables or chains which might break while lifting or pulling objects.

#### 3.3 Excavation Entry Procedure

Any entry to an excavation or trench should be performed in accordance with the Barr excavation entry procedure. All excavation entry should be cleared with an appropriately trained Barr employee. For excavation entry procedures, please see APPENDIX G: EXCAVATION ENTRY. If soil samples are required from excavation materials, samples should be taken from the backhoe bucket or from the spoils pile, or other nonentry methods, whenever possible.

### 3.4 Lighting

Work areas must have adequate lighting for employees to see to work and identify hazards. Work should be limited to daylight hours unless artificial lighting is provided. Barr employees should carry flashlights in all normally dark areas, such as confined spaces.

### 3.5 Lifting

Heavy objects, such as pumps and generators, should be lifted with proper lifting techniques, such as using one's legs to lift rather than one's back, and preferably by at least two persons. Material handling equipment to move the object should be used when an object is either too heavy or bulky to move normally without risk of injury.

### 3.6 Deteriorated/Abandoned Buildings

Abandoned buildings on site may be structurally unstable. Roof, ceiling, floors, walkways, and doors may be damaged. Hard hats, steel-toed boots and safety glasses should always be used when entering those buildings. An initial walk through with a buddy should be conducted in or near any abandoned facility to identify physical hazards. These types of buildings should be entered only if necessary and may be considered a confined space.

### 3.7 Electrical Power Hazards

Electrical equipment must be properly grounded or double insulated and should be inspected prior to use. Any electrical equipment in questionable condition should not be used. Operation of electrical equipment in wet conditions must be avoided unless equipment electric service are specifically designed for water immersion.

### 3.8 Energized Equipment

Work on or near energized equipment should not be conducted until the equipment is appropriately locked-out. Appropriate lock-out procedures prevent the equipment from being turned on while a person is working on or near the equipment.

### 3.9 Compressed Gas Cylinders

Compressed gas cylinders must be secured in an upright position with a chain or other securing devices away from heat sources. Empty containers should be marked empty, have protective valve caps securely in place, and secured in an upright position.

### 3.10 Slipping

Slipping on wet, muddy surfaces can be minimized by diverting water away from work area, avoiding slippery surfaces, or by providing a better surface to walk on, such as laying boards on the muddy surface. Boots with good treads or boot covers should be worn if the area is wet or muddy. Walking in puddles, drilling mud and drilling additives should be avoided. Slipping on snowy or icy surfaces should be minimized by avoiding these surfaces whenever possible.

### 3.11 Limitations Due To Personal Protective Equipment

The use of personal protective equipment may limit visibility, hearing, or manual dexterity. In addition, wearing personal protective equipment may require additional physical exertion of the wearer. These limitations are evaluated during the preparation of the PHASP and should be re-addressed, as appropriate, prior to performing a particular task.

### 3.12 Noise Extremes

Noise exposure may occur on site from heavy equipment operation, especially while working in the area of operating equipment. A general rule of thumb to determine if noise levels are high enough to require hearing protection is to observe if two persons standing approximately 2 feet apart have to raise their voices to converse. If conversation cannot occur without shouting, noise levels probably exceed 85 dBA and hearing protection should be utilized. Hearing protection is available, in the form of ear plugs, ear muffs, or both, and should be used when working around heavy equipment.

### 3.13 Ionizing Radiation

Sites that have been used by hospitals and research facilities should be particularly suspect of posing an ionizing radiation hazard. These materials may be found in drums, including lab packs, as either a solid or liquid. The best precaution for individuals working at these types of landfills is constant monitoring for ionizing radiation using a geiger counter or similar monitoring instrument. Initial monitoring should be conducted to detect high levels of radiation where radiation is suspected to be present. Exposure monitoring is continuously conducted for Barr employees when their TLD badge is worn. If radioactive materials are suspected on site, protective measures will be discussed in SECTION 1: PROJECT HEALTH AND SAFETY INFORMATION of the PHASP.

### 3.14 Nonionizing Radiation

Barr occasionally uses ground conductivity meters, such as a Geonics EM31. The frequency this device generates is 9.8 kHz. A comparison to the ACGIH TLV indicates that this frequency is not contained within the frequency ranges of concern.

### 3.15 Heat Stress

Heat-induced occupational illnesses, injuries and reduced productivity occur in situations in which the total heat load (environmental plus metabolic) exceeds the body's capacities to maintain normal body functions without excessive strain. Heat stress is defined as the sum of the heat generated in the body plus the heat gained from the environment minus the heat lost from the body to the environment. The body's response to heat stress is called heat strain. The level of heat stress at which excessive heat strain will result depends on the heat-tolerance of the individual. Certain predisposing factors may reduce an individual's ability to tolerate heat stress and are addressed in SECTION 3.14.1.

Using personal protective equipment may put a worker at increased risk of developing heat stress. Health effects may range from heat rash or heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, such as temperature and relative humidity, protective clothing which limits natural heat loss through perspiration, workload, and the individual characteristics of the worker.

It is the responsibility of the project team members to inform the Project Health and Safety Team Leader if any of the predisposing factors listed below apply to that individual. This enables the Project Health and Safety Team Leader to monitor the individual if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a heat-related illness/disorder.

### 3.15.1 Predisposing Factors

Predisposing factors that will increase the individual's susceptibility to heat stress are listed below.

- Lack of physical fitness - Such individuals experience more physiological strain including a higher heart rate, a higher body temperature, less efficient sweating, and a slightly higher oxygen consumption as compared to fit individuals.
- Obesity - Overweight individuals produce more heat per unit surface area than thin individuals, and have a lowered ability to dissipate heat.
- Age - Older individuals may have a decreased ability to cope with heat stress.
- Dehydration - Dehydrated individuals will have a decreased ability to cool the body by sweating. Diarrhea can cause dehydration.
- Alcohol, medications and drug use - Alcohol consumption may dehydrate individuals and certain medications or drugs may act as diuretics. Hence the individual may have a decreased ability to lose heat by sweating.
- Infection, sunburn, illness, and certain chronic diseases - These factors may interfere with the body's normal mechanisms to lose heat.
- Heart conditions or circulatory problems - Heat stress may place an additional strain on the heart and circulatory system that could harm the individual as well as decrease the individual's physiologic response.
- Low salt diet - Could affect the individual's electrolyte balance.
- Pregnancy.
- Previous history of Heat Stroke or Heat Exhaustion - May increase the individual's susceptibility to heat stress.
- Heavy work load - Will generate metabolic heat thereby increasing the heat stress placed on the individual.
- The use of PPE over light summer clothing - This will decrease the ability of an individual to lose heat by sweating as evaporative cooling can no longer occur.
- Lack of acclimatization - Acclimatization is the gradual introduction of workers into a hot environment to allow their body to physiologically adjust to hot working conditions. Acclimatized individuals generally have lower heart rates and lower body temperatures. In addition, they sweat sooner and more profusely and even have more dilute sweat (thereby losing less electrolytes) than nonacclimatized individuals.

### 3.15.2 Prevention of Heat Stress

Prevention of heat-related illness begins with a recognition that hot and/or humid environments can have serious impact on both project personnel and the project itself. In particular, it must be recognized that work in hot environments can reduce both the quantity and quality of work that field teams can deliver. By planning for heat-related effects and building preventative measures into the project schedule and budget, the impact of heat on the project and personnel can be minimized.

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing heat stress related illness/disorders. These include fluid and electrolyte replenishment, the provision of shelter from the sun and heat, work schedule adjustment, the use of cooling devices, acclimatization, heat stress monitoring, and employee education, as discussed below.

- **Fluid and Electrolyte Replenishment:** Personnel should drink about 16 ounces of water before starting work and drink water at every break. To encourage water consumption, cool water and disposable cups should be made available. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, personnel should be encouraged to drink more. Replacing body fluids with an electrolyte replacement such as Gatorade is an option. It is advisable to have Gatorade on site if the air temperature is 70°F or more and the workers are performing tasks with a moderate to heavy work load in chemical resistant clothing.

- **Shelter From The Sun and Heat:** Air-conditioned (if possible) or shaded areas should be made available for rest periods. Sitting in an air-conditioned truck is an acceptable option. Shading of work areas is often a practical and economical option.
- **Work Schedule Adjustment:** Scheduling work for early mornings and/or late afternoons will avoid the hottest parts of the day, and reduce the heat stress placed on personnel; rotation of personnel will help reduce overexertion of workers; and, adjusting the work-rest schedule will help personnel recover from the effects of heat stress periodically. Frequent short breaks are more effective in preventing heat illness than one or two long breaks.
- **Use of Cooling Devices:** The use of cooling devices like field showers, hose-down areas, or cooling vests should be considered for project tasks that involve heavy work loads in chemical-resistant clothing. Contact the Barr Safety Staff for information on cooling vests.
- **Acclimatization:** Acclimatization is the gradual introduction of workers into a hot environment to allow their body to physiologically adjust to hot working conditions. Acclimatized individuals generally have lower heart rates and lower body temperatures. In addition, they sweat sooner and more profusely and even have more dilute sweat (thereby losing less electrolytes) than nonacclimatized individuals.
- **Heat Stress Monitoring:** Monitoring of the environment or personnel for potential heat stress should be initiated when the ambient air temperature is 70°F. There are several ways to monitor heat stress; measuring heart rate, oral temperature, loss of body weight, and the Wet Bulb Globe Temperature using a Reuter-Stokes RSS 217 or a Questemp 15 Heat Stress Monitor. Barr employees are advised to measure their heart rates as a primary means of heat stress monitoring when impermeable protective clothing is worn.
- **Employee Education:** Workers have already been trained to recognize and treat the effects of heat stress during the 40 hour training. Signs, symptoms and treatment of heat stress should be discussed in project safety meetings. The Buddy System will help in preventing heat stress once the employees are trained to recognize the signs and symptoms of heat stress.

### 3.15.3 Suggested Heat Stress Prevention Guidelines

It may not always be practically or economically feasible to implement all of the above prevention measures. Follow the criteria given below as a guide to choosing which measures to implement.

Ambient air temperature is 70°F or more:

- Replenish fluids and electrolytes; provide cool potable water and electrolyte replacement drink
- Provide shelter from the sun and heat

Ambient air temperature is 70°F or more and chemical-resistant clothing is being used:

- Replenish fluids and electrolytes; provide cool potable water and electrolyte replacement drink
- Provide shelter from the sun and heat
- Adjust work schedules if feasible
- Initiate Heat Stress Monitoring and/or the use of cooling devices.

### 3.15.4 Heat Stress Monitoring

Heat stress monitoring may be performed by monitoring the heart rate. Heart rate should be measured at the beginning of the work-shift, at regular intervals, and at the start of each rest period. Refer to TABLES B-2 and B-3: RECOMMENDED HEART RATE MONITORING FREQUENCY.

- If the heart rate is <110 beats per minute (bpm), personnel may continue the current work-rest schedule.
- If the heart rate is >110 bpm, take a 10 minute break.
  - Monitor heart rate at the end of the rest break. If not <110 bpm, rest until the heart rate is <110 bpm.



- Reduce the current work time between breaks by approximately 25%.
- If the next scheduled monitoring session shows a heart rate >110 bpm once again reduce the work time between breaks by 25%

Table B-2

Recommended Heart Rate Monitoring Frequency  
Relative Humidity Less Than 80%

	70°-80°F	80°-90°F	90°-100°F	>100°F
Light Summer Clothing	Every 3 hours	Every 3 hours	Every 2 hours	Every 2 hours
Kleengard or cotton coveralls	Every 3 hours	Every 3 hours	Every 2 hours	Every hour
Tyvek, Polycoated Tyvek, Saranex Tyvek	Every 2 hours	Every 2 hours	Every hour	Stop work and reassess

Table B-3

Recommended Heart Rate Monitoring Frequency  
Relative Humidity is 80% or Greater

	70°-80°F	80°-90°F	90°-100°F	>100°F
Light Summer Clothing	Every 3 hours	Every 2 hours	Every 2 hours	Every hour
Kleengard or cotton coveralls	Every 2 hours	Every 2 hours	Every hour	Every hour
Tyvek, Polycoated Tyvek, Saranex Tyvek	Every 2 hours	Every hour	Every hour	Stop work and reassess

### 3.15.5 Heat Stress First-Aid Treatment Guidelines

TABLE B-4: HEAT STRESS FIRST-AID TREATMENT GUIDELINES describes the symptoms of the different levels of heat stress and guidelines for first aid treatment.

Table B-4

## Heat Stress First-Aid Treatment Guidelines

Heat Cramps	
Cause: Excessive water loss	
Symptoms:	First-Aid Treatment Guidelines:
<ul style="list-style-type: none"> <li>• Muscular pain in arms, legs, abdomen</li> <li>• Faintness, dizziness, exhaustion</li> <li>• Normal temp, cool, moist skin</li> </ul>	<ul style="list-style-type: none"> <li>• Administer sips of Gatorade or water (½ glass every 15 minutes)</li> <li>• Do not massage cramping muscles (unless it does not increase pain)</li> <li>• Relax person</li> </ul>
Heat Exhaustion	
Cause: Large amount of water loss; blood circulation diminishes	
Symptoms:	First-Aid Treatment Guidelines:
<ul style="list-style-type: none"> <li>• Moist, clammy skin, usually pale</li> <li>• Dilated pupils</li> <li>• Weak, dizzy, nauseous, headache</li> <li>• Normal or low temperatures</li> </ul>	<ul style="list-style-type: none"> <li>• Move to cool place</li> <li>• Apply cold, wet compresses to skin</li> <li>• Raise feet 8 to 12 inches</li> <li>• Administer sips of water or Gatorade (½ glass every 15 minutes)</li> <li>• Get medical attention</li> </ul>
Heat Stroke	
Cause: Body overheats; temperature rises; no sweating occurs	
Symptoms:	First-Aid Treatment Guidelines:
<ul style="list-style-type: none"> <li>• No sweating occurs</li> <li>• Dry, hot skin, usually red</li> <li>• Constricted pupils</li> <li>• Hot body temperature (105-110°F)</li> <li>• Strong, rapid pulse</li> <li>• Unconsciousness may occur</li> <li>• Muscular twitching</li> </ul>	<ul style="list-style-type: none"> <li>• Get emergency medical assistance as soon as possible</li> <li>• Remove from sunlight</li> <li>• Wet down body with cool water or rubbing alcohol</li> <li>• Elevate head/shoulders</li> <li>• Wrap in wet, cold wrapping</li> <li>• Once cooled to 102°F, stop cooling measures</li> </ul>

## 3.16 Cold Stress

Fatal exposures to cold have been reported when persons fail to escape from low environmental air temperatures or from immersion in low temperature water. Hypothermia, a condition in which the body's deep core temperature falls significantly below 98.6°F, can be life threatening. A drop in core temperature to 95°F or lower must be prevented.

Air temperature is not sufficient to determine the cold hazard of the work environment. The windchill must be considered as it contributes to the effective temperature. The body's physiologic defense against cold includes constriction of the blood vessels, inhibition of the sweat glands to prevent loss of heat via evaporation, glucose (fuel) production, and involuntary shivering to produce heat by rapid muscle contraction.

The frequency of accidents increases with cold exposures as the body's nerve impulses slow down, individuals react sluggishly and numb extremities make for increased clumsiness. Additional safety hazards include ice, snow blindness, reflections from the snow, and possible skin burns from contact with cold metal.

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There are certain predisposing factors that make an individual more susceptible to cold stress. It is the responsibility of the project team members to inform the Project Health and Safety Team Leader if any of the predisposing factors listed below apply to that individual. This enables the Project Health and Safety Team Leader to monitor the individual if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a cold-related illness/disorder.

### 3.16.1 Predisposing Factors

Predisposing factors that will increase an individual's susceptibility to cold stress are listed below.

- **Dehydration** - The use of diuretics and alcohol, and diarrhea can cause dehydration. Dehydration reduces blood circulation to the extremities.
- **Fatigue during physical activity** - Exhaustion reduces the body's ability to contract blood vessels. This results in the blood circulation occurring closer to the surface of the skin and the rapid loss of body heat.
- **Age** - Some elderly and very young individuals may have an impaired ability to sense cold.
- **Alcohol consumption** - Alcohol dilates the blood vessels near the skin surface resulting in body heat loss.
- **Sedative drugs** - Sedatives may interfere with the transmission of impulses to the brain thereby interfering with the body's physiological defense against cold.
- **Poor circulation** - Vasoconstriction of peripheral vessels reduces blood flow to skin surface.
- **Heavy work load** - Heavy work loads generate metabolic heat and make an individual perspire. If perspiration is absorbed by the individual's clothing and is in contact with skin, cooling of the body will occur.
- **The use of PPE** - PPE usage which traps sweat inside the PPE may increase an individual's susceptibility to cold stress.
- **Lack of acclimatization** - Acclimatization, the gradual introduction of workers into a cold environment allows the body to physiologically adjust to cold working conditions.
- **History of cold injury** - Previous injury due to cold exposures may result in increased cold sensitivity.

### 3.16.2 Prevention of Cold Stress

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing cold related illness/disorders. These include acclimatization, fluid and electrolyte replenishment, eating a well-balanced diet, wearing warm clothing, the provision of shelter from the cold, thermal insulation of metal surfaces, adjusting work schedules, and employee education.

- **Acclimatization:** Acclimatization is the gradual introduction of workers into a cold environment to allow their body to physiologically adjust to cold working conditions. However, the physiologic changes are usually minor and require repeated uncomfortably cold exposures to induce them.
- **Fluid and Electrolyte Replenishment:** Cold, dry air can cause employees to lose significant amounts of water through the skin and lungs. Dehydration affects the flow of blood to the extremities and increases the risk of cold injury. Warm, sweet, caffeine-free, nonalcoholic drinks and soup are good sources to replenish body fluids.
- **Eating a Well-Balanced Diet:** Restricted diets including low-salt diets can deprive the body of elements needed to withstand cold stress. Eat high energy food throughout the day.
- **Warm Clothing:** It is beneficial to maintain air space between the body and outer layers of clothing in order to retain body heat. However, the insulating effect provided by such air spaces is lost when the skin or clothing is wet.
- **Work Schedule Adjustment:** Schedule work during the warmest part of the day if possible; rotate personnel; and, adjust the work schedule to enable employees to recover from the effects of cold stress.

The parts of the body most important to keep warm are the feet, hands, head and face. As much as 40% of body heat can be lost when the head is exposed.

• **Recommended Clothing includes:**

- Inner layers (t-shirt, shorts, socks) should be of thin, thermal insulating, nonmoisture absorbent material, moisture wicking, such as polypropylene.
- Wool or thermal trousers. Denim is not a good protective fabric since it absorbs moisture very well.
- Felt-lined, rubber-bottomed, leather-topped boots with a removable felt insole is preferred. Wool socks with polypropylene inner socks. Consider winter boots one half size larger than regular size to accommodate thick socks.
- Wool shirts/sweaters should be worn over inner layer.
- A wool cap is good head protection. Use a liner under a hard hat.
- Mittens are better insulators than gloves. Wool liners for either mittens or gloves.
- Face masks or scarves are good protection against wind.
- Tyvek/polycoated tyvek provide good wind protection.
- Wear loose fitting clothing, especially footwear. Consider winter boots a half size larger than regular shoes to accommodate thick socks.
- Carry extra clothing in vehicle. Change out of wet clothes or socks.

- **Provision of Shelter from the Cold:** Shelters with heaters should be provided for the employees' rest periods if possible. Sitting in a heated vehicle is a viable option. Care should be taken that the exhaust is not blocked and that windows are partially open to provide ventilation.
- **Thermal Insulation of Metal Surfaces:** At temperatures of 30°F or lower, cover metal tool handles with thermal insulating material if possible.
- **Employee Education:** Employees have already been trained to recognize and treat the effects of cold stress during their 40 hour training. Signs, symptoms and treatment of cold stress should be reviewed in project safety meetings where applicable. The Buddy System will help in preventing cold stress once the employees are trained to recognize the signs and symptoms of cold stress.

**3.16.3 Suggested Cold Stress Prevention Guidelines**

It may not be practically or economically feasible to implement all the above prevention measures. Follow the guidelines given below when the ambient air temperature is -5°F or lower:

- Contact the Project Manager or the Project Health and Safety Contact to determine if the project team should be on-site in such temperatures.
- Dress warm.
- Replenish fluids and electrolytes at regular intervals.
- Provide shelter from the cold.
- Adjusting work-rest schedules.

**3.16.4 Cold Stress First-Aid Treatment Guidelines**

TABLE B-5: COLD STRESS FIRST-AID TREATMENT GUIDELINES describes symptoms of different stages in cold stress and first-aid treatment guidelines.

**Table B-5**  
**Cold Stress First-Aid Treatment Guidelines**

Frostbite		
Stages:		
• Incipient (frost nip)	May be painless. Tips of ears, nose, cheeks, fingers, toes, chin affected. Skin blanched white.	
• Superficial	Affects skin/tissue just beneath skin; turns purple as it thaws. Skin is firm, waxy; tissue beneath is soft, numb.	
• Deep	Tissue beneath skin is solid, waxy, white with purplish tinge. Entire tissue depth is affected.	
First-Aid Treatment Guidelines:		
• Incipient	Warm by applying firm pressure—no rubbing; or blow warm breath on spot; or submerge in warm water (102-110°F).	
• Superficial	Provide dry coverage, steady warmth; submerge in warm water.	
• Deep	Hospital care is needed. Don't thaw frostbitten part if needed to walk on. Don't thaw if there is danger of refreezing. Apply dry clothing over frostbite. Submerge in water; do not rub.	
General Hypothermia		
Stages:	Symptoms of Hypothermia:	
• Shivering	Muscle Tension	Coordination Loss
• Indifference	Uncontrollable Shivering	Stumbling
• Decreased Consciousness	Decreased Muscle Function	Fatigue
• Unconsciousness	Speech Distortion	Forgetfulness
• Death	Glassy Stare	Freezing Extremities
	Blue, Puffy Skin	Dilated Pupils
	Slow Pulse	Shallow Breathing
Emergency Response:		
<ul style="list-style-type: none"> <li>• Keep person dry; replace wet clothing</li> <li>• Apply external heat to both sides of patient using available heat sources, including other bodies</li> <li>• Give warm liquids—not coffee or alcohol—after shivering stops and if conscious</li> <li>• Handle gently</li> <li>• Transport to medical facility as soon as possible</li> <li>• If more than 30 minutes from a medical facility, warm person with other bodies</li> </ul>		

### 3.16.5 Windchill Index

The human body senses "cold" as a result of both air temperature and wind velocity. Cooling of exposed flesh increases rapidly as the wind velocity goes up. Frostbite can occur at relatively mild temperatures if wind penetrates the body insulation. For example, when the actual air temperature of the wind is 40 °F and its velocity is 30 mph, the exposed skin would perceive this situation as an equivalent still air temperature of 13°F.

If the actual wind speed is not known, the following examples are provided to approximate wind speed.

- 5 mph = Light flag moves
- 10 mph = Light flag fully extended
- 15 mph = Raise newspaper sheet
- 20 mph = blowing and drifting snow

TABLE B-6: WINDCHILL INDEX shows a chart that can help in determining the windchill index. Site work should be terminated when there is a great danger of freezing exposed flesh.

Table B-6  
Windchill Index

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	5	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-56	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In <hr with dry skin. Maximum danger of false sense of security.			INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.				

Equivalent chill temperature requiring dry clothing to maintain core body temperature above 36°C (96.8°F) per cold stress TLV.

From: *Threshold Limit Values and Biological Exposure Indices*, 1994-1995, ACGIH. Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Personal Protective  
C/ Equipment (PPE)  
Program

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## Appendix C: Personal Protective Equipment (PPE) Program

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## Appendix C: Personal Protective Equipment (PPE) Program

### 1.0 Scope

Barr has established this personal protective equipment (PPE) program for hazardous waste operations to provide guidelines and procedures that enable employees to most effectively use the PPE provided to them. Discussion of protective equipment normally used by Barr personnel, except respiratory protection, is provided in this section. Respiratory protection is described in APPENDIX E: RESPIRATOR PROGRAM.

### 2.0 PPE Selection

Levels of personal protection vary according to the activity being conducted and the hazards that may be encountered. Personal protective equipment selection is made on the basis of site-specific chemical and physical hazards. The U.S. EPA terminology for protective equipment will be used: Levels A, B, C and D. Within each level, there may be variations on the specific PPE used and are designated as D1, D2, D3, D4, C1, C2, C3, C4, etc. A brief description of the levels of protection that may be required is provided below. Levels of protection for a particular project will be specified in SECTION 1 of the PHASP.

#### 2.1 Level D

Level D protection should be used when a hazardous atmosphere is not present nor is expected based on planned work activities. Level D protection is designed to offer eye and skin protection. Level D does not provide protection from inhalation exposure to hazardous substances. Sub-levels within Level D (D1, D2, D3, D4) are designed to adjust the level of skin and body protection to the appropriate site conditions.

#### 2.2 Level C

Level C protection is designed to offer air purifying respiratory protection in addition to body protection to a comparable sublevel in Level D, and will be used when:

- The types of air contaminants have been identified, an air-purifying respirator (APR) that can remove the contaminants is available, the air contaminants have adequate warning properties, oxygen levels are sufficient, and the criteria for the use of an APR have been met (APPENDIX E: RESPIRATOR PROGRAM).
- Concentrations of airborne organic compounds in the breathing zone are 5 ppm (benzene equivalent) above background for a period of 10 minutes with a ceiling of 50 ppm (benzene equivalent), or above project specific action levels.
- Concentrations of contaminate particulates which may become airborne in the breathing zone are greater than established action level for those contaminants.

Sublevels within Level C (C1, C2, C3, C4) are designed to adjust the level of skin and body protection appropriate to site conditions with a particular level of respiratory protection. Respirator selection is based on the types of inhalation hazards present on the site.

When Level C respiratory protection is required, a full face or half-mask air-purifying respirator with High Efficiency Particulate (HEPA) filters, or organic vapor/acid gas cartridges, or chemical specific cartridges, or a combination of both filters and cartridges, or canister will be used. The PHASP designates the appropriate combination in SECTION 1: PROJECT HEALTH AND SAFETY INFORMATION. APPENDIX E: RESPIRATOR PROGRAM describes respirator usage guidelines in greater detail.

### 2.3 Level B

Level B protection is designed to offer supplied air respiratory protection in the form of a self-contained breathing apparatus (SCBA) or supplied air (SA) through an air line and will be used when:

- Concentrations of total airborne organic compounds exceed 50 ppm of unknown organics in the breathing zone, or project specific action levels
- Concentrations of hazardous substances in the air are immediately dangerous to life and health (IDLH) or above the maximum use limit of an APR with full-face mask
- Oxygen deficient or potentially oxygen deficient atmospheres (19.5 percent or less) are possible
- Confined space entry requires Level B protection.

Level B protective equipment will consist of all equipment specified for Level C protection except the full-face APR equipment will be replaced with self-contained breathing apparatus (SCBA), or a supplied air (SA) system with an egress bottle, if IDLH conditions are possible.

Use of Level B requires that buddies actually accompany each other and, in addition, at least one other person must be at Level B and available as backup, ready to provide emergency assistance.

### 2.4 Level A

Level A protective equipment should be worn when the highest level of respiratory, skin, and eye protection is needed. Barr does not expect to work on projects involving this level of protection. In the event that Barr employees are required to work in Level A Protection, additional special training and equipment will be required.

Personal protective equipment (PPE) selected to protect against potential hazards is described in TABLE C-1 -PERSONAL PROTECTION LEVELS. These protection levels may be modified (upgraded or downgraded) by the Barr Project Health and Safety Team Leader depending on specific site conditions, equipment configuration, status or phase of site activities, air monitoring results and previous experience. The level of PPE used should be reevaluated for appropriateness upon the first indication of suspected hazardous substances through the detection of odors from exposed soils/fluids, appearance of oiliness in soils, or unnatural soil discoloration.

Table C-1  
Personal Protection Levels

	D1	D2	D3	D4	C3	C4
<b>General Safety Equipment</b>						
Hard Hat <sup>(1)</sup>	R	R	R	R	R	R
Safety Glasses	R	R	R	R	R	R
Chemical Goggles	O	O	O	O	O	O
Face Shield	O	O	O	O	O	O
Hearing Protection <sup>(2)</sup>	R	R	R	R	R	R
Safety Vest <sup>(3)</sup>	R	R	R	R	R	R
<b>Boots</b>						
Steel-Toed Boots/Insulated Steel-Toed Boots	R	R	R	-	R	-
Chemical Resistant Steel-Toed Boots <sup>(4)</sup>	-	O	O	R	O	R
Boot Covers <sup>(5)</sup>	-	R	R	R	R	R
<b>Clothing</b>						
Cotton Coveralls	-	O	-	-	-	-
Kleengard	-	O	-	-	-	-
Tyvek	-	-	R	-	R	-
Poly-Coated Tyvek	-	-	O	R	O	R
<b>Respirators</b>						
½ Mask Respirator with HEPA/OVAG cartridges	-	-	-	-	R	R
Full Face with GMC-H cartridge	-	-	-	-	O	O
Emergency Life Support Apparatus (ELSA) 5-Minute Escape Bottle	-	O	O	O	O	O
<b>Gloves</b>						
Inner Glove (Surgical)	-	R	R	R	R	R
Outer Glove (Nitrile, neoprene, monkey grip) <sup>(6)</sup>	-	O	R	R	R	R

R = Required O = Optional - = Not Required

#### Special Considerations

- 1 Hard hat not required in the absence of construction activities or overhead physical hazards, unless required by client.
- 2 Hearing protection is required during soil boring and monitoring well installation when personnel may be exposed to high noise levels (for example, cannot hear normal conversation or have to raise voice to be understood).
- 3 Brightly colored safety vests should be used when working on and adjacent to roadways, or working in remote areas during hunting season.
- 4 Chemical resistant steel-toed boots may be used instead of steel-toed leather boots and boot covers if water is available for DECON.
- 5 Boot covers or chemical resistant boots required if walking in contaminated soil or liquids.
- 6 A second pair of surgical gloves may be used where outer gloves are required.

### 3.0 Personal Protective Equipment Use Guidelines

#### 3.1 Protective Clothing

The criteria used to determine the need for PPE for a specific activity are listed below. Specific personal protective equipment needs for project work is discussed in SECTION 1 of the PHASP.

- 3.1.1 **Hard Hats:** Required when the potential for construction hazards or overhead hazards exist or when intrusive activities involving powered equipment are conducted. Examples include soil borings, well installation, test excavating or other construction/investigation activities involving the observation of heavy equipment operations. In addition, hard hats are required if required by other contractors or by the owner.

- 3.1.2 Safety Glasses:** Required when activities involving powered equipment such as soil boring, well installation, test excavation or other activities involving the observation of heavy equipment operations occur. Side shields are required when work involves handling of materials being in close proximity to chemical, grinding, grouting operations, or concrete pouring or other activities where particles/aerosol can become easily airborne and may irritate the eye if eye contact occurs.
- A splash shield should be worn when materials known or suspected to contain hazardous substances may splash or spray to the face.
- 3.1.3 Steel-Toed Boots:** Required when activities involving powered equipment such as soil boring, well installation, test excavating or other construction/investigation activities involving the observation of heavy equipment operations. In addition, steel-toed boots are required if required by contractors, owner or when activities may involve carrying/handling heavy materials. Steel-toed boots with steel midsoles should be used when work may involve walking on sharp objects, such as when walking on landfills.
- 3.1.4 Cotton Coveralls/Work Clothes:** Cotton coveralls may be used to protect skin and work clothes from nontoxic particulates such as dust, dirt, and mud. May be used when contact with soils or water known or suspected to contain hazardous substances is restricted to handling samples.
- 3.1.5 Kleengard:** Kleengard is a disposable and breathable fabric, that can be used to protect skin and work clothes from nontoxic substances. Required when activities are restricted to the exclusion zone and where contact with soils or water known or suspected to contain hazardous substances is restricted to handling samples. If torso contact with known or suspected to contain hazardous substances materials cannot be avoided, an upgrade to tyvek will be necessary. Kleengard is not acceptable when working on coal tar sites or sites known or suspected to contain PCB, unless all contact with those hazardous substances can be avoided.
- 3.1.6 Tyvek:** Tyvek is disposable nonporous material. It may be used to provide protection from toxic particulates such as lead dust and asbestos, and may be used for wind protection in the winter. Required when tasks may involve bodily contact with materials known or suspected to contain hazardous substances. This would involve collecting of samples from backhoe bucket during test trenching and working with driller to collect samples, and other activities where splashing or "getting dirty" is likely.
- 3.1.7 Poly-coated Tyvek:** Poly-coated tyvek is a disposable, polyethylene-coated tyvek material. It may be used as protection from potential chemical liquid splash. Required when bodily contact may occur with high concentrations of hazardous substances. Also required when concentration of hazardous substances is unknown and activities may encounter bodily contact with these substances or when investigation/remediation activity generates a splash potential.
- 3.1.8 Saranex Tyvek:** Saranex tyvek is a saran-coated tyvek material and may be used when a higher level of skin protection is required than that offered by poly-coated tyvek.
- 3.1.9 Chemical Resistant Boots:** Chemical-resistant steel-toed boots may be worn when walking in materials known or suspected to contain hazardous substances is anticipated or when work may involve walking in wet conditions. They may be worn uncovered only when there is sufficient water on the site for thorough decontamination, or when the nature of the contaminant facilitates quick volatilization from footwear. Two pair of disposable boot covers or a heavier overboot may be worn over leather steel-toed boots in lieu of one pair over chemical-resistant boots.

**3.1.10 Boot Covers:** Disposable boot covers will be worn over leather steel-toed work boots when walking in materials known or suspected to contain hazardous substances. They may also be worn when muddy conditions are anticipated. They may be worn over chemical-resistant boots when there is not sufficient water on the site for decontamination.

**3.1.11 Gloves:** Inner vinyl, nitrile, or latex surgical gloves (4 mil thickness) will be worn as a precaution when handling materials known or suspected to contain hazardous substances or when a dermal (skin) hazard exists. They may also be worn inside outer gloves when there is a greater likelihood of contact with materials known or suspected to contain hazardous substances to provide protection against degradation/leakage of the outer gloves.

Outer gloves of nitrile, vinyl, neoprene, butyl, or viton (11-14 mil thickness) will be worn when handling materials known or suspected to contain hazardous substances or when a serious dermal (skin) hazard exists. Selection of glove type is based on degradation and permeability of glove material to expected contaminants on the site. In most cases, a second pair of surgical gloves may be used where outer gloves are required. In cold weather, insulated orange vinyl-coated gloves (monkey-grips) may be worn as outer gloves.

One pair of surgical gloves (nitrile, latex) is required when handling containers that contain samples known or suspected to contain hazardous substances. A second pair of surgical gloves is required when collecting the sample known or suspected to contain hazardous substances from split spoon sampler or bailer or when performing headspace analysis. This second pair (outer layer) should be replaced immediately after handling or collecting the sample. This outer layer should consist of a thicker material (nitrile, neoprene) when handling high concentrations of hazardous substances or materials known or suspected to contain coal tar or PCB or when collecting a sample from the backhoe bucket.

#### 4.0 Work Task Duration

In selecting personal protective equipment, the estimated duration of job tasks and project duration is considered, in addition to other considerations. Protective equipment is chosen that will provide protection for a full work shift, or for the duration of the task to be accomplished. If site conditions are such that protective equipment cannot provide adequate protection for the duration of the task, several factors are considered to determine appropriate work task duration, including:

- Clothing/glove permeation and penetration rates for chemicals
- Respirator/filter cartridge capacity and breakthrough time
- Ambient temperature and weather conditions
- Integrity of the tyvek, boot covers, and gloves

These factors are incorporated into the selection of personal protective equipment, and will be addressed as appropriate in the PHASP. In addition, as soon as the integrity of any PPE is compromised, the work task should stop until the PPE can be replaced.

#### 5.0 Maintenance and Storage

Nondisposable protective equipment such as hard hats, boots, and safety glasses will be decontaminated, if necessary, prior to leaving the project site. Respirators will be decontaminated after each use. Most disposable clothing such as tyvek, boot covers and outer gloves are discarded at the end of a work shift. If, after inspection, and decontamination procedures, it has been determined that the clothing may be reused, these items may be stored appropriately until re-used. All used disposable clothing will be discarded upon demobilization from a site.

## 6.0 Decontamination and Disposal

Decontamination and disposal procedures for personal protective equipment are covered in APPENDIX D: DECONTAMINATION.

## 7.0 Training and Fitting

All Barr employees with 24- and 40-hour training have been trained in the use and selection of personal protective equipment, and have been provided hands-on training on using PPE. Each Barr employee with 40-hour training has been fit-tested with a respirator according to the procedures outlined in APPENDIX E: RESPIRATOR PROGRAM. All Barr field employees (regardless of training level) will be fitted for and provided with steel-toed boots, hard hat, and safety glasses with side shields (and safety sunglasses, if necessary). A large inventory of protective clothing, gloves, and boot covers is maintained in various sizes. Each employee is encouraged to try on the various sizes to determine the best fitting size of all personal protective equipment. After selection of the proper PPE, and in addition to the PPE training received during 24- and 40-hour training, each employee will receive training by a member of the health and safety staff or by the equipment maintenance technician. The training will include, but is not limited to how to properly don, doff, adjust, and wear PPE; the limitations of the PPE; and the proper care, maintenance, useful life, and disposal of the PPE. Each trained employee will demonstrate this knowledge, and their ability to properly use the PPE, before being allowed to perform work that requires the use of PPE.

## 8.0 Dressing/Removal Procedures for Personal Protective Equipment

Clothing required as protection from exposure to hazardous substances will be put on at the site before entry into the exclusion zone. If protective outer garments are necessary, the suit (tyvek, poly-coated tyvek, saranex, etc.) will be put on first, followed by boots, boot covers and gloves. Hems on the legs of protective clothing should be worn outside of chemical resistant boots and taped at the ankle, if necessary. If boot covers are used, the hems should be tucked into the boot cover and taped below the knee at approximately mid-calf level. Hems on the sleeves of protective clothing should be worn outside of gloves, and taped at the wrist if necessary. Respirators will be put on following the guidelines provided in APPENDIX E: RESPIRATOR PROGRAM, prior to putting on gloves.

Barr employees leaving the exclusion zone will remove and decontaminate their equipment and protective clothing, if necessary, at designated DECON zones as described in FIGURE D-1: DECONTAMINATION PROCEDURES of SECTION 4 and in APPENDIX D: DECONTAMINATION. Respirator removal procedures to be followed are found in APPENDIX E: RESPIRATOR PROGRAM.

## 9.0 PPE Inspection

All Barr employees will periodically inspect the integrity of their own PPE, both before and during use. The frequency and degree of inspection depends on the specific article and its frequency of use. The primary inspection will be done by the user before use. Inspection guidelines are presented in the following sections.

### 9.1 Protective Clothing Inspection

- Visually inspect for tears, nonuniform coatings, imperfect seams, malfunctioning closures.
- Hold up to the light to check for pinholes.
- Flex product to check for cracks and deterioration.

## 9.2 In-Use Inspection

PPE should be periodically inspected for signs of ripping/tearing or heavy contamination of PPE. In the event of torn/ripped or heavily contaminated PPE, Barr employees should proceed to the DECON zone to remove and replace the PPE.

## 9.3 Respiratory Protection Inspection

The inspection of respiratory protection equipment is discussed in APPENDIX E: RESPIRATOR PROGRAM.

## 10.0 Evaluation of Effectiveness of PPE Program

The Barr PPE program is evaluated annually for its effectiveness. This evaluation occurs at refresher training sessions and is also reviewed regularly on project basis by the Project Health and Safety Contact.

## 11.0 PPE Limitations

Selection of chemical-resistant clothing should be performed by personnel trained in evaluation of the clothing and its limitations.

Consideration of the following factors and limitations is generally considered in the selection of PPE described in the PHASP.

- Not all materials protect against all chemicals and chemical combinations, and not all materials provide a barrier for prolonged exposure periods. Since most contaminated soils/water are mixtures of hazardous substances, there is limited permeation data available for those mixtures. Selection should be made for clothing offering the widest range of protection against the chemicals expected on site.
- Protective clothing is generally nonporous and is designed to prevent skin exposure to hazardous substances. Consequently, the nonporous nature does not allow for sufficient cooling of the body through sweating and other heat release body functions. Temperature extremes will be considered in the PHASP when selection of PPE is made, and suggestions will be made on duration of use of PPE, and recommended break schedule as appropriate to weather conditions. Guidelines for working in PPE during temperature extremes is discussed in APPENDIX B: HAZARD EVALUATION.
- In cold weather, the polymer coating on some disposable clothing may become inflexible and tear more easily.
- The use of boot covers to protect footwear from contamination may increase the potential for slipping hazards.

Other limitations to consider are:

- Ability of material to withstand the physical stress of tasks (e.g., boot covers torn by walking on sharp objects).
- Degree to which protective clothing may interfere with a worker's ability to perform tasks (e.g., full-facepiece respirator interferes with ability to read survey scope).



*D/* Decontamination  
Procedures

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## Appendix D: Decontamination Procedures

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### Figures

Figure D-1 Decontamination Procedures

### Attachments

Attachment D-1 Guide to Management of Investigation-derived Wastes (U.S. EPA Fact Sheet, January 1992)

## Appendix D: Decontamination Procedures

### 1.0 Scope

Personal protective equipment (PPE) and monitoring equipment must either be decontaminated or properly discarded upon exiting from the exclusion zone. This practice prevents cross-contamination to clean areas. All Barr employees and Barr's subcontractors must enter and exit the exclusion zone through the decontamination (DECON) zone.

### 2.0 Decontamination Methods

Decontamination methods should involve: physically removing contaminants, neutralizing contaminants, or removing contaminants through a combination of both physical and chemical means. The types, physical states, and concentrations of contamination present will determine the feasibility of DECON and appropriate method of decontamination.

### 3.0 Procedures

A step-by-step representation of decontamination procedures and recommended locations for decontamination stations for Levels D, C, and B is provided in FIGURE D-1: DECONTAMINATION PROCEDURES in this section and in SECTION 4 of the PHASP. The Project Health and Safety Team Leader will monitor decontamination procedures and may modify, if appropriate, to suit site conditions and specific protective levels in use. General standard operating procedures to be followed are:

- Minimize contact with contaminants in order to minimize the need for extensive decontamination.
- Sampling/monitoring equipment, when feasible, should be enclosed in plastic bags to prevent contamination and the need for DECON.
- Decontamination solution of soap or other detergent, such as trisodium phosphate (TSP) and water should be used.
- Gloves, boot covers, and disposable outer clothing should be rolled down with the insides out and discarded in appropriate containers.

### 4.0 Equipment Decontamination

Air monitoring equipment will be decontaminated before leaving the site. While the decontamination procedures should be appropriate for the type and concentration of site contaminants expected, the selected procedure should not be damaging to the monitoring equipment. Generally, wiping the equipment with a damp cloth or cloth soaked in a mild soap solution is sufficient to remove most contaminants. If solvent cleaning or more rigorous cleaning techniques are required, the Equipment Maintenance Technician should be consulted.

Other site equipment such as vehicles, soil, or other sampling equipment should be decontaminated prior to leaving the site. Vehicle decontamination at minimum should consist of steam or pressure washing tires. Depending upon site conditions, the use of solvents or more extensive pressure washing may be necessary. Site-specific equipment decontamination procedures, if required, are discussed in the Health and Safety Plan.

## 5.0 Waste Disposal

Barr personnel on site will determine whether protective clothing is contaminated, in which case it will remain on site for future disposal by the owner. Personal protective clothing may be considered contaminated when the level of contamination present meets hazardous waste criteria. Clothing which does not carry levels of contamination sufficient to warrant this categorization may be disposed of as garbage. ATTACHMENT D-1 should be consulted for further guidance.

It is unlikely that any nonvisible residue adhering to disposable protective clothing would be present at the levels required to meet hazardous waste criteria. Protective clothing that is not visibly dirty will therefore be placed in garbage bags to be disposed of as garbage. All visibly dirty protective clothing will be placed in drums or secured plastic bags to remain on site or otherwise disposed of as determined in the work scope of the project.

## 6.0 Management and Disposal of Decontamination Solutions and Other Investigation-derived Wastes

Decontamination solutions and other investigation-derived wastes must be decontaminated or be properly disposed. In determining if a particular management disposal option is appropriate, the following should be considered:

- The contaminants, their concentrations, and the total volume of decontamination solution
- Media potentially affected (e.g., groundwater, soil) under management options
- Location of the nearest population(s) and the likelihood and/or degree of site access
- Potential exposure to workers
- Potential for environmental impacts

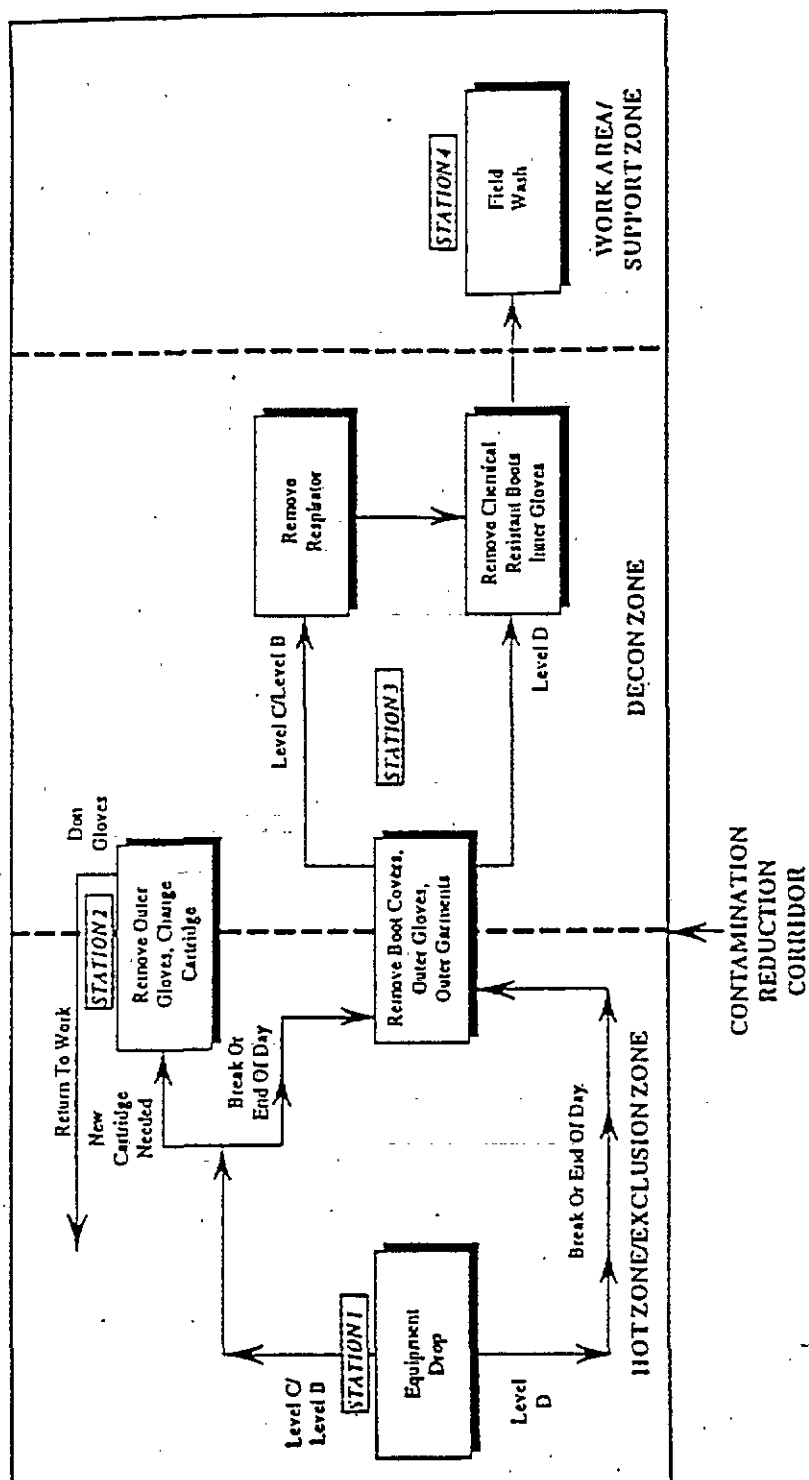
The U.S. EPA has released a fact sheet (January 1992) summarizing appropriate methods for managing decontamination solutions and other investigation-derived waste. ATTACHMENT D-1: GUIDE TO MANAGEMENT OF INVESTIGATION-DERIVED WASTES contains the information in the U.S. EPA fact sheet which has been retyped to improve its legibility.

## 7.0 Showers and Change Rooms

Showers and/or change rooms may be provided for Barr employees when the duration of the project activities extends beyond a six-month continuous period or will be provided when site conditions warrant the need for a separate change area.

*FIGURE D-1*

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1. Decontaminate Equipment
2. Remove boot covers
3. Remove outer gloves and tyvek.
4. Remove respirator
5. Place all disposed PPE in garbage bags or drum
6. Remove inner gloves and place in garbage bags or drum
7. Wash hands and face with water, alcohol wipes, other cleaning wipes
8. Shower as soon as possible off-site

**Figure D-1**

## DECONTAMINATION PROCEDURES

*ATTACHMENT D-1*

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## Attachment D-1

# Guide to Management of Investigation-Derived Wastes

CERCLA field investigation activities (e.g., remedial investigation/feasibility studies and remedial designs) may result in the generation of waste materials that may pose a risk to human health and the environment. These investigation-derived wastes (IDW) may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues (e.g., ash, spent carbon, well development purge water) from testing of treatment technologies and pump and treat systems; contaminated personal protective equipment (PPE); and solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment. The management of IDW must ensure protection of human health and the environment and comply with (or waive) regulatory requirements that are applicable or relevant and appropriate requirements (ARAR). This fact sheet presents an overview of possible IDW management options, discusses the protectiveness requirements and ARARs associated with these options, and outlines general objectives established for IDW management under Superfund.<sup>1</sup>

The general options for managing IDW (see Highlight 1) are collection and either (1) immediate disposal or (2) some type of interim management. Interim management may include storage or other temporary measures. As discussed below, the specific option selected will depend on the type of waste produced, its relative threat to human health and the environment, and other site-specific conditions.

### IDW Management Requirements

When managing IDW, site managers are required to choose an option that: (1) is protective of human health and the environment and (2) complies with (or waives) ARARs, as described below.

#### Protectiveness

In determining if a particular management/disposal option is protective, site managers should consider the following:

- The contaminants, their concentrations, and total volume of IDW;
- Media potentially affected (e.g., ground water, soil) under management options;
- Location of the nearest population(s) and the likelihood and/or degree of site access;
- Potential exposures to workers; and
- Potential for environmental impacts.

As a general rule, it will be necessary to use best professional judgment, in light of the site-specific conditions, to determine whether an option is protective of human health and the environment. For example, a site manager may determine that storing IDW temporarily until the final action or returning IDW to its source is protective, based on knowledge that the material poses low risk and/or that the final action will address any risks posed by the wastes and there will be no unacceptable risks in the interim.

Alternatively, if the site includes or is near residential areas, the site is unsecured, and/or contaminants appear to be present at unacceptable levels, it may not be protective to return excavated soil to the source. Storing IDW in containers in an on-site, secure location, or sending it off site immediately may be more appropriate.

Site managers also need to consider the potential effects of IDW management-related activities on environmental media. For example, pouring contaminated purge water on the ground around a well may not be prudent, because such an action could mobilize any hazardous constituents present in the soil or introduce contaminants into clean soil.

#### Compliance with ARARs

Remedial Investigation/Feasibility Study (RI/FS) and Remedial Design (RD) actions must comply with ARARs "to the extent practicable, considering the exigencies of the situation" (NCP, 55 FR 8756, emphasis added); therefore, it generally will not be necessary to obtain a waiver if an ARAR cannot be attained during these actions. If a site manager determines that, based on site-specific factors, compliance with an ARAR is practicable but an ARAR waiver is warranted for an RI/FS or RD action, an interim action waiver may be available if the final remedy will attain the ARAR. An action memorandum should be prepared for the waiver, the state given an opportunity to comment, and the decision document placed in the administrative record.

<sup>1</sup>Management of treatability study and treatment pilot wastes is discussed in *Guide for Conducting Treatability Studies Under CERCLA*, Interim Final, December 1989, EPA/540/2-89/058. Information on management of IDW generated during Preliminary Assessments and Site Investigations is provided in *Management of Investigation-Derived Waste During Site Investigations*, May 1990, EPA/540/G-91/009.



### Highlight 1: IDW Management Options

Type of IDW	Generation Processes*	Management Options
Soil	<ul style="list-style-type: none"> <li>Well/test pit installation</li> <li>Borehole drilling</li> <li>Soil sampling</li> </ul>	<ul style="list-style-type: none"> <li>Return to boring, pit, or source immediately after generation</li> <li>Spread around boring, pit, or source within the AOC<sup>+</sup></li> <li>Consolidate in a pit (within the AOC)</li> <li>Send to on-site TDU<sup>+</sup></li> <li>Send to TDU off site immediately</li> <li>Store for future treatment and/or disposal</li> </ul>
Sludges/sediment	<ul style="list-style-type: none"> <li>Sludge pit/sediment sampling</li> </ul>	<ul style="list-style-type: none"> <li>Return to boring, pit or source immediately after generation</li> <li>Send to on-site TDU</li> <li>Send to TDU off site immediately</li> <li>Store for future treatment and/or disposal</li> </ul>
Aqueous liquids (ground water, surface water, drilling fluids, other wastewaters)	<ul style="list-style-type: none"> <li>Well installation/development</li> <li>Well purging during sampling</li> <li>Ground water discharge during pump tests</li> <li>Surface water sampling</li> </ul>	<ul style="list-style-type: none"> <li>Discharge to surface water</li> <li>Pour onto ground close to well (nonhazardous waste)</li> <li>Send to on-site TDU</li> <li>Send to off-site commercial treatment unit</li> <li>Send to POTW<sup>+</sup></li> <li>Store for future treatment and/or disposal</li> </ul>
Decontamination fluids	<ul style="list-style-type: none"> <li>Decontamination of PPE<sup>+</sup> and equipment</li> </ul>	<ul style="list-style-type: none"> <li>Send to on-site TDU</li> <li>Evaporate (for small amounts of low contamination organic fluids)</li> <li>Send to TDU off site immediately</li> <li>Store for future treatment and/or disposal</li> </ul>
Disposable PPE	<ul style="list-style-type: none"> <li>Sampling procedures or other on-site activities</li> </ul>	<ul style="list-style-type: none"> <li>Send to on-site TDU</li> <li>Place in on-site industrial dumpster</li> <li>Send to TDU off site immediately</li> <li>Store for future treatment and/or disposal</li> </ul>

\* The generation processes listed here are provided as examples. IDW may also be produced as a result of activities not listed here.

+ AOC: Area of Contamination (AOCs at a site may not yet have been identified at the time of the RI/FS); TDU: Treatment/disposal Unit; POTW: Publicly Owned Treatment Works; PPE: Personal Protective Equipment

Potential ARARs for IDW at CERCLA sites include regulations under the Resource Conservation and Recovery Act (RCRA) (including both Federal and State underground injection control (UIC) regulations), the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substances Control Act (TSCA), and other State environmental laws. How these various requirements may direct or influence IDW management decisions is described below.

Resource Conservation and Recovery Act (RCRA). Certain sections of the RCRA Subtitle C hazardous waste regulations (e.g., land disposal restrictions and storage restrictions) may be ARARs for IDW should RCRA hazardous waste be identified at a site. (Note that RCRA may be relevant and appropriate even if the IDW is not a RCRA hazardous waste.) A waste is hazardous under RCRA if it is listed as such in 40 CFR 261.31 - 261.33 or if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Site managers should not assume that a waste considered to pose a potential risk at a CERCLA site is a listed or characteristic RCRA hazardous waste. Until there is positive evidence (records, test results, other knowledge of waste properties) that the IDW is a RCRA hazardous waste, site managers should manage it in a protective manner (but not necessarily in accordance with Subtitle C requirements). Business records or facility processes should be examined to determine whether RCRA listed wastes were generated and are present in the IDW. For characteristic wastes, site managers should rely on testing results or on knowledge of the material's properties. If best professional judgment and available information indicate that, for protectiveness reasons (or because RCRA requirements are relevant and appropriate), IDW is best managed as a "hazardous waste" management in accordance with Subtitle C requirements is prudent, regardless of whether it is known to be a RCRA waste.

If aqueous liquid IDW is considered a RCRA hazardous waste, the site manager should determine whether the Domestic Sewage Exclusion (DSE) applies to the discharge of that IDW to a POTW. The RCRA DSE exempts domestic sewage and any mixture of domestic sewage and other wastes that passes through a sewer system to a POTW for treatment from classification as a solid waste and, therefore, as a RCRA hazardous waste (40 CFR 261.4).

#### • Land Disposal Restrictions

If IDW is determined to be a RCRA hazardous waste and subject to the land disposal restrictions (LDRs), "land disposal" of the IDW will be prohibited unless specified treatment standards are met (see Superfund LDR Guides #5 and #7, Determining When LDRs Are Applicable to CERCLA Response Actions and Determining When LDRs Are Relevant and Appropriate to CERCLA Response Actions, OSWER Directive 9347.3-05FS and 9347.3-08FS, June 1989 and December 1989 and the NCP, 55 FR 8759, March 8, 1990). "Land disposal" occurs when wastes from different AOCs are consolidated into one AOC; when wastes are moved outside an AOC (for treatment or storage) and returned to the same or a different AOC; or when wastes are excavated, placed in a separate hazardous waste management unit such as an incinerator or tank within the AOC, and then redeposited into the AOC.

Storing IDW in a container ("a portable device in which a material is stored, transported, treated, disposed of, or otherwise handled" (40 CFR 260.10)) within the AOC and then returning it to its source, however, is allowable without meeting the specified LDR treatment standards. Under the definition of "hazardous waste management unit" (40 CFR 260.10), EPA states that "a container alone does not constitute a unit; the unit includes the containers and the land or pad upon which they are placed." Therefore, returning IDW that has been stored in containers (not tanks or other RCRA-regulated units) within the AOC to its source does not constitute land disposal, as long as containers are not managed in such a manner as to constitute a RCRA storage unit as defined in 40 CFR 260.10. In addition, sampling and direct replacement of wastes within an AOC do not constitute land disposal.

#### • Storage

Subtitle C outlines the storage requirements for RCRA hazardous wastes. Under RCRA, "storage" is defined as "the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR 260.10).

On-site Superfund actions are only required to comply with the substantive standards of other laws (see 40 CFR 300.5, definitions of applicable or relevant and appropriate requirements). Superfund sites are also exempt from permit requirements under CERCLA §121(e). Therefore, site managers are not required to comply with administrative requirements triggered by RCRA storage deadlines (e.g., contingency planning, inspections, recordkeeping). Generally equivalent administrative activities are undertaken at Superfund sites, however, under existing Superfund management practices.

Site managers storing known RCRA hazardous waste must comply with the substantive, technical requirements of 40 CFR Parts 264 and 265 Subparts I (containers), J (tanks), and L (waste piles), to the extent practicable. (See Highlight 2 for a summary of these technical requirements for each type of unit). In addition, the ground-water monitoring requirements of 40 CFR Parts 264 and 265 Subpart F are potential ARARs, and to the extent they are determined to be ARARs at a site, they should be attained to the extent practicable (or waived). (In many cases, ground-water monitoring conducted during the RI/FS will provide protection equivalent to the Subpart F requirements.)

(NOTE: Under the LDRs, restricted RCRA hazardous waste may not be stored at a site unless the storage is solely for the purpose of accumulating sufficient quantities of the waste to facilitate proper disposal, treatment, or recovery (see 40 CFR 268.50). Generally, storing IDW until a final disposal option is selected in a Record of Decision (ROD) and implemented during the remedial action is allowable storage under the RCRA LDR storage prohibition.)

#### • Recordkeeping and Manifesting

If hazardous wastes are sent off site, the site manager must comply with both administrative and substantive elements of the RCRA generator requirements of 40 CFR Part 262 and LDR notification and certification requirements of Part 268. (For example, a site manager must prepare an LDR notification and certification when restricted wastes are sent off site to a land disposal facility.) These standards include requirements such as manifests for shipping waste that list all hazardous waste listings and characteristics applicable to the waste (see 40 CFR 262.11), packaging and transport requirements, and recordkeeping requirements.

If the LDRs are applicable, the following information should be collected and available before the removal of wastes to an off-site disposal facility: EPA hazardous waste number, LDR treatment standards, manifest number for the waste shipment, and waste analysis data.

#### • Underground Injection Control (UIC) Program

Under the UIC regulations, RCRA hazardous wastes may be injected into Class I permitted wells. In some cases, hazardous liquids, such as extracted ground water from pump and treat operations, may be injected into a Class IV UIC well. For example, ground water contaminated with RCRA hazardous wastes may be injected into Class IV permitted

**Highlight 2:  
Examples of Technical Storage  
Requirements**

RCRA storage requirements, applicable to both less-than-90-days generators and permitted or interim status storage facilities, may include the following substantive requirements:

**Containers 40 CFR 264 Subpart I and 265 Subpart I**

- Containers must be in good condition
- Wastes must be compatible with container
- Container must be closed during storage
- Container storage areas must have a containment system that can contain 10 percent of the volume of containers or of the largest container
- Spilled or leaked waste must be removed from the collection area as necessary to prevent overflow

**Tanks 40 CFR 264 Subpart J and 265 Subpart J**

- Tanks must have a secondary containment system that includes a liner, a vault, a double-walled tank, or an equivalent device (applies only to certain tanks)

**Waste Piles 40 CFR 264 Subpart L and 265 Subpart L**

- Waste piles must have a liner and a leachate collection and removal system
- Owners/operators must have a run-on control system to prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm
- Owners/operators must have a run-off management system to collect and control at least the water volume resulting from a 24-hour, 25-year storm
- This is a partial list of substantive requirements. For more detail, see 40 CFR Part 264 and 265.

wells if it is part of a CERCLA response action or a RCRA corrective action and if it has been treated to "substantially reduced hazardous constituents prior to such injection ..." (RCRA § 3020(b)). (See *Applicability of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment Reinjection*, OSWER Directive #9234.1-06, December 1989.)

• **NonRCRA Hazardous Wastes**

Some nonRCRA hazardous waste may be subject to management requirements under Subtitle D of RCRA as solid wastes. Subtitle D regulates disposal of solid waste in facilities such as municipal landfills. Therefore, nonRCRA hazardous IDW, such as decontaminated PPE or equipment, may need to be disposed of in a Subtitle D facility (depending on State requirements).

Clean Water Act (CWA). Discharges of aqueous IDW to surface water and publicly owned treatment works (POTWs) may be required to comply with CWA Federal, State, and local requirements. Requirements to be met may include water quality criteria, pretreatment standards, State water quality standards, and NPDES permit conditions. Direct discharges to on-site waters are subject only to substantive requirements, while discharges to POTWs and other off-site discharges

must comply with both substantive and administrative CWA requirements (including permitting requirements). (See *Guide to Discharging CERCLA Aqueous Wastes to POTWs*, June 1991 and *CERCLA Compliance with the CWA and SDWA*, #9234.2-06FS, January 1991.)

Toxic Substances Control Act (TSCA). If IDW contains PCBs treatment and/or disposal requirements may apply during its management. TSCA requirements regulate the disposal of material contaminated with PCBs at concentrations of 50 ppm or greater as found on site (i.e., based on sample analysis and not the PCB concentration of the source material (e.g., transformer fluid)). (See *PCB Guidance Manual*, EPA/540/G-90/007, August 1990.) In addition, TSCA storage requirements may apply that limit the time that PCBs may be stored to one year. Furthermore, if PCB materials are mixed with a RCRA hazardous waste, they may be regulated by the LDR California list prohibitions. (See RCRA sections 3004(d)(2)(D) and (E).)

Department of Transportation (DOT) requirements. Where IDW will be disposed of off site or transported on public roads to a site, DOT requirements for containerizing, labeling, and transporting hazardous materials and substances may apply.

State requirements. Promulgated State regulations that are legally enforceable, timely identified, and more stringent than Federal regulations may be potential ARARs for IDW managed on site. Substantive requirements of State law that may be ARARs for IDW management include State water quality standards, direct discharge limits, and RCRA requirements (including underground injection control regulations) promulgated in a State with an authorized RCRA hazardous waste management program (as well as programs authorized by State laws). Off-site, substantive and administrative requirements of State law may apply.

Off-Site Policy. In addition to complying with requirements of Federal and State laws, all off-site disposal of wastes must comply with CERCLA section 121(d)(3) and the CERCLA Off-Site Policy (OSWER Directive No. 9334.11 (November 13, 1987)). The Off-Site Policy establishes criteria for selecting an appropriate treatment, storage, and disposal facility (TSDF), including release criteria for all facilities that receive wastes from CERCLA-authorized or funded response actions. In addition, receiving facilities must be in compliance with all "applicable laws."

Before shipping wastes off site, approval should be obtained for the proposed disposal facility from EPA's Regional Off-Site Policy Coordinator. In addition, EPA has adopted a policy for Superfund wastes shipped out of State that written notification should be provided to receiving States (OSWER Directive 9330.2-07, September 14, 1989).

**General Objectives for IDW Management**

In addition to the two requirements of protectiveness and compliance with ARARs to the extent practicable (on site) or compliance with applicable law (off site), EPA has identified two general objectives that Superfund site managers should consider when managing IDW: (1) minimization of IDW generation; and (2) management of IDW consistent with the final remedy for the site. The extent to which these objectives can be achieved is highly dependent on site-specific circumstances.

**IDW Minimization**

Site managers should strive to minimize the generation of IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action. Generation of IDW can be minimized through proper planning of all remedial activities that may generate IDW, as well as through use of screening information from the site inspection. The potential problems of managing IDW should be a factor in choosing an investigative method. Site managers should consider techniques such as replacing solvent-based clean-

aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic between clean and hot zones, and drilling methods and sampling techniques that generate little waste. Examples of such techniques include using gridding techniques to minimize the number of test pits or using soil borings instead of test pits. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer instead of coring. Site managers should also be careful to keep hazardous wastes separate from nonhazardous wastes.

#### Management Consistent with Final Remedy

Most IDW (with the exception of nonindigenous IDW) generated during the course of an investigation are intrinsic elements of the site. If possible, IDW should be considered part of the site and should be managed with other wastes from the site, consistent with the final remedy. This will avoid the need for separate treatment and/or disposal arrangements.

Because early planning for IDW management can prevent unnecessary costs and the use of treatment or disposal capacity, IDW management should be considered as early as possible during the remedial process. A key decision to be made is whether the waste will best be treated/disposed of immediately or addressed with the final remedy. If addressed with the final remedy, IDW volumes should be considered in the FS. In addition, when IDW is stored on site, it should be managed as part of the first remedial action/operable unit that addresses the affected media.

#### Selection of IDW Disposal Options

The following sections present the Agency's presumptions for IDW management that have been established based on the above considerations. The actual option selected should be based upon best professional judgment and should take into account the following factors:

The type and quantity of IDW generated (sludge/soil, aqueous liquid, nonindigenous IDW)

- Risk posed by managing the IDW on site (e.g., based on site access controls, contaminant concentrations)
- Compliance with ARARs, to the extent practicable (on site)
- IDW minimization
- Whether the final remedy is anticipated to be an off-site or on-site remedy (or this information is unknown) and whether IDW can be managed consistent with the final remedy

#### Off-site Final Remedies

If a site manager believes that the final remedy will involve off-site disposal of wastes, EPA's presumption is to manage the IDW as part of the remedial action addressing the waste/medium. Thus, until the final action, the IDW may be stored (e.g., drummed, covered waste pile) or returned to its source. However, the management option selected should also take into account any protectiveness concerns, ARARs, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

There are several potential reasons why it may be advisable to store IDW until the final action. First, because wastes at the site will be shipped off site eventually, returning IDW (especially sludges and soil) to its source would require that it be excavated again. Thus, site managers may consider it practical to containerize IDW as soon as it is generated. Second, storing IDW in containers may be more protective than returning it to its source. Third, because off-site actions may

trigger such requirements as the LDRs, temporary storage will eliminate the need to meet these additional requirements until the final remedy.

In some cases, circumstances may lead site managers to choose to return the IDW to its source. This may be appropriate if it is determined that returning IDW to the source is protective and that storage at the site is not possible or practicable (i.e., given State or community concerns). In other cases, long-term storage may not be protective, and immediate off-site disposal may be a better option.

**Example:** A site involves volatile organic RCRA hazardous wastes that will likely be sent off site for final treatment and disposal. Site conditions are such that temporary storage of IDW is considered protective until the remedial action begins. Because off-site disposal will trigger RCRA disposal requirements such as the LDRs and immediate containerization would be more protective than redepositing into the source area at the time of sampling, the site manager decides to containerize the IDW (and comply with RCRA substantive technical tank and container standards) until the final action is initiated.

#### On-site Final Remedies (or Final Management in an Unknown Location)

When final management of wastes is likely to occur on site, the management presumptions vary depending on the type of IDW produced.

##### Sludge/soil

Generally, the Agency expects sludge or soil IDW will be returned to its source if short-term protectiveness is not an issue. The reason behind this presumption is that IDW that may pose a risk to human health and the environment in the long term will be addressed by the final action. Storage of RCRA hazardous IDW in containers within the AOC prior to returning it to the source will not trigger the LDRs, as long as the containers are not managed in such a way as to constitute a RCRA storage unit as defined in 40 CFR 260.10. Therefore, it may be possible to store IDW temporarily before redispersing of it. However, EPA believes that, in many cases, returning sludges and soils to their source immediately will be protective and will avoid potentially increased costs and requirements associated with storage. Site-specific decisions on how to manage sludge and soil IDW may ultimately vary from the presumption based on protectiveness, ARARs, and/or community concerns.

Example 1: The soil at a site contains wastes that are expected to be stabilized on site during the final remedial action. The site manager determines that sending soil IDW off site is not cost-effective, because off-site disposal would involve testing and transport costs for a relatively small amount of waste. Instead, knowing that the site is secure and that redistributing the waste at the source will not increase site risk or violate ARARs, the site manager decides to return soil IDW to the source area from which it originated.

Example 2: A site manager determines that returning highly contaminated PCB wastes to the ground at a site is not protective because of the potential risks associated with the material; instead, the site manager chooses to drum the waste and send it off site (in compliance with TSCA). (Off-site disposal may occur immediately or at a later date.)

Example 3: Soil IDW contaminated with a RCRA hazardous waste is generated from a soil boring. The site manager decides to put the IDW back into the borehole immediately after generation, but ensures that site risks will not be increased (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas) and that the contamination will be addressed in the final remedy.

#### Aqueous liquids

EPA has not established a presumption for the management of aqueous liquid IDW (e.g., ground water). Site managers should determine the most appropriate disposal option for aqueous liquids on a site-specific basis. Parameters to consider, especially in making the protectiveness decision, include the volume of IDW, the contaminants present in the ground water, the presence of contaminants in the soil at the site, whether the ground or surface water is a drinking water supply, and whether the ground-water plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components. Examples of aqueous liquid management decisions considering these factors are presented in the following box.

Example 1: Disposable PPE (e.g., gloves, shoe covers) becomes contaminated with RCRA hazardous waste during the field investigation. The site manager containerizes and disposes of this IDW in compliance with RCRA Subtitle C requirements.

Example 2: Disposable equipment becomes contaminated during a field investigation. The site manager decontaminates them and sends them to a Subtitle D facility.

#### Community of Concerns

Residents of communities near a CERCLA site, local governments, or States may have concerns about certain disposal methods or long-term storage of IDW at the site. As with all CERCLA activities, site managers should evaluate community concerns regarding disposal of

Example 1: A site manager has large volumes of ground water IDW and does not know if it is contaminated. Pouring this IDW on the ground would not be protective, because it may contaminate previously uncontaminated soil or may mobilize contaminants that are present in the soil. Therefore, the manager stores the water in a mobile tank until a determination is made as to whether the water and soil are contaminated until the final action.

Example 2: IDW is generated from the sampling of background, upgradient wells. Because there are no community concerns or evidence of any soil contamination from other sources, the site manager decides to pour this presumably uncontaminated IDW on the ground around the well.

Example 3: Purge water from a deep aquifer is known to be contaminated with a RCRA hazardous waste. At this site, if this water were poured on the ground, it could contaminate a previously uncontaminated shallow aquifer that is a potential drinking water source and would have to comply with the LDRs. The site manager decides to containerize the water within the AOC and store it until the final remedy.

#### Nonindigenous IDW

Nonindigenous IDW (e.g., sampling materials, disposable PPE, decontamination fluids) should be stored until the final remedy or disposed of immediately. If contaminated, such waste may not be disposed of onto the ground because such an action would add contamination that was not present when activities began at the site (e.g., solvents used for decontamination). If nonindigenous IDW contaminated with RCRA hazardous waste, it must be managed in accordance with RCRA Subtitle C requirements. Otherwise, site managers may generally dispose of it in an on-site dumpster (for PPE).

IDW in deciding what action to take. For example, if a community is concerned about the direct discharge of IDW water to surface water on site, site managers may want to consider sending the water to a POTW if one is located nearby. In some instances, it may be appropriate to prepare fact sheets, include options in other community relations documents, or explain IDW management decisions at public meetings prior to actions.

NOTICE: The policies set out in this memorandum are not final agency action, but are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance any time without public notice.

AR307505

## Appendix E: Respirator Program

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## **Appendix E: Respirator Program**

### **1.0 Purpose**

The purpose of the Barr's Respirator Program is to:

- Provide respiratory protection for employees who may require respiratory protection during the course of their work.
- Provide respiratory protection for employees while working on sites covered by the Barr Health and Safety Policy Manual.
- Provide emergency escape respiratory protection for employees working on sites covered by the Barr Health and Safety Policy Manual.

### **2.0 Policy**

Barr will provide respirators for employees who may require respiratory protection during the course of their work, and to provide emergency escape respiratory protection for employees working on projects which may expose them to hazardous substance release situations.

### **3.0 Respirator Equipment**

Respirator selection is made according to the American National Standards Institute (ANSI Z88.2-1980, Practices for Respiratory Protection). Barr provides respirators approved by National Institute of Occupational Safety Health (NIOSH) and Mine Safety and Health Administration (MSHA).

#### **3.1 Types of Respirators**

Barr provides the following types of respirators for respiratory protection under varying conditions:

- Mine Safety Appliance (MSA) Ultratwin full facepiece respirator (Protection Factor = 50); air-purifying to be worn with MSA filters and/or cartridges.
- 3M Easi-Air dual cartridge half mask respirator (Protection Factor = 10); air-purifying to be worn with 3M filters and/or cartridges.
- 3M 9970 High Efficiency Disposable Respirator. Respirator (Protection Factor = 5); air-purifying respirator, protects against dusts/fumes/mists/radionuclides.
- MSA Self-Contained Breathing Apparatus (SCBA), ultralite air mask, pressure demand type, Model FHR, pressure demand air mask (Protection Factor = 10,000).
- MSA Supplied Air (SAR); to be worn with MSA ultralite air mask, pressure demand type, Model FHR air mask, (Protection Factor = 2,000).
- Survivair Series 2000 half-mask respirator (Protection Factor = 10), air-purifying respirator to be worn with Survivair filters/cartridges.
- Survivair Series 4000 Full Facepiece respirator (Protection Factor = 50), air-purifying respirator to be worn with Survivair filters/cartridges.
- MSA Ultravue gas mask respirator (Protection Factor = 50), air-purifying respirator to be worn with a MSA canister.
- International Safety Instruments, Inc. (ISI) Emergency Life Support Apparatus (ELSA); 5 minute supply of air for escape use only.

### 3.2 Types of Filters and Cartridges

The types of filters and cartridges that Barr provides to be worn with full facepiece and half mask air-purifying respirators are described in this section. They are stored in the safety equipment room.

- MSA GMC-H (Approval No. TC-23C-153). Combination cartridge for organic vapors (not formaldehyde), acid gases, and particulates, including asbestos-containing dusts and mists and radionuclides. Approved for use by NIOSH/MSHA in atmospheres containing not more than 1,000 ppm (parts per million) organic vapors, 10 ppm Cl, 50 ppm HCl, 50 ppm SO<sub>2</sub>, 1 ppm ClO<sub>2</sub>, 100 ppm H<sub>2</sub>S (escape only).
- MSA HEPA (Approval No. TC-21C-135). High efficiency particulate air filter for removal of radionuclides and dust fumes and mists having a time weighted average of less than 0.05 mg/m<sup>3</sup>, including asbestos dusts and mists.
- 3M No. 7253 (OVAG) (Approval No. TC-23C-446). Chemical cartridge for organic vapors, sulfur dioxide, hydrogen chloride, and chlorine.
- 3M No. 7255 (HEPA) (Approval No. TC-21C-265). Cartridge for dusts, fumes, mists, radionuclides, radon daughters, and asbestos-containing dusts and mists.
- 3M No. 7218 (Approval No. TC-21C-289). Filter for dusts and mists.
- Survivair HEPA (Approval No. TC-210-244). High efficiency particulate air filter for removal of radionuclides and dusts, fumes, and mists having a time weighted average of less than 0.05 mg/m<sup>3</sup>. This includes asbestos dusts and mists.
- Survivair GMC-H (Approval No. TC-23C-450). Combination cartridge for organic vapors, acid gases, and particulates (not formaldehyde), including asbestos-containing dusts and mists and radionuclides. Approved for use by NIOSH/MSHA in atmospheres containing not more than 1,000 ppm (parts per million) organic vapors, 10 ppm Cl, 50 ppm HCl, 50 ppm SO<sub>2</sub>, 1 ppm ClO<sub>2</sub>, 100 ppm H<sub>2</sub>S (escape only).
- MSA Chemical-specific canister filter (Approval No. TC-14G-84). Approved for respiratory protection against a designated chemical for a limited period of time, specified on the label.

### 3.3 Air Quality

When air-supplied respirators are used, the breathing air shall meet the Compressed Gas Association Standards - Grade D breathing air quality or better.

### 3.4 Air Cylinders

Cylinders used to supply breathing air are tested and maintained. The SCBA air-cylinders are at approximately 2,200 pounds per square inch (psi) pressure when full with 45 ft<sup>3</sup> of air. The supplied air (SAR) tanks are at approximately 2,640 psi when full with 312 ft<sup>3</sup> of air. Compressed air cylinders are visually inspected annually and hydrostatically tested once every five years. These test dates are noted with a label for visual inspection testing and a stamp for hydrostatic testing.

Full cylinders for SCBA respirators may be shipped and stored in the SCBA case. If not in the SCBA case, they should be secured during shipping and storage. MSA SCBA air-cylinders are exempt from special transportation requirements (DOT-E 7277-2216).

SAR air-cylinders should be secured upright during shipping and storage. The cylinders should be labeled as "nonflammable gas" and may require hazardous materials shipping papers. These air-cylinders are classified as air, compressed, UN1002, Hazard Class 2.2.

### 3.5 Corrective Lenses

Contact lenses will be removed before any air-supplied respirator (SCBA/SAR) is worn due to the low humidity found in Grade D breathing. Barr provides spectacle kits for all employees who may need optical correction while wearing a full facepiece respirator. These insert into the facepiece mask and do not compromise the facepiece-to-face seal.

## 4.0 Respirator Selection

Respirators will be selected based on the types of hazards present. Factors considered when determining which type of respirator to use are:

- Contaminant level. When the suspected exposure level to a hazardous substance(s) may be greater than a workplace exposure level or Barr action level. This level must be known if air-purifying respirators are to be used.
- Toxicity of hazardous substance. The identity of the hazardous substance(s) must be known if air-purifying respirators are to be used.
- Length of anticipated exposure to hazardous substance(s).
- Potential for increase in exposure levels.
- Presence of other airborne hazardous substance(s).
- Hazardous substance(s) which cannot be identified.
- Monitoring method used to determine hazardous substance(s).

The following limitations apply to use of air-purifying respirators:

- Hazardous substance(s) must be known.
- There must be at least 19.5 percent oxygen.
- The atmosphere must not be an IDLH condition.
- Hazardous substance(s) must have good warning properties.
- Atmosphere must be monitored continuously.
- Filter/cartridge media must be appropriate for hazardous substance(s). The project health and safety plan or a member of the health and safety staff should be consulted for advice on selection of the appropriate filter/cartridge.

### 4.1 Respiratory Level of Protection

For hazardous waste-related projects, the PHASP will describe the level of respiratory protection that will be necessary. These levels are:

**Level D:** No respirator required. Emergency life support apparatus (ELSA) optional.

**Level C:** Full face or half face air-purifying respirator with a filter/cartridge required. A full face air-purifying respirator with a canister may be substituted. ELSA may be required.

**Level B:** SCBA/SAR respirator required. A five minute escape bottle may also be required. Barr employees wearing Level B protection will receive additional respirator training.

**Level A:** In the event that Barr staff are required to work at Level A protection, additional special training and equipment will be required. A five minute escape bottle may also be required.

Table E-1, Performance of GMC-H Cartridges, shows the performance of a GMC-H cartridge combination for selected chemicals. When the GMC-H cartridge performance is unsatisfactory, when the breakthrough time in minutes is less than 10 minutes, or when the odor threshold is significantly greater than the STEL, a GMC-H cartridge will not be used.

Table E-1  
Performance of GMC-H Cartridges

Selected Chemical of Concern	TLV <sup>1</sup> (ppm)	STEL <sup>2</sup>	ODOR Threshold (ppm)	GMC-H Respirator Cartridge Adequate	Breakthrough Times (min.)		
					1%	10%	99%
Acetone	750	1,000	100	Yes	37.1	46.0	119
Benzene	10 1(PEL) <sup>3</sup>	5	4.68	Yes	73.3	86.6	170
Carbon Tetrachloride	5 2(PEL)		>10	Yes	77	90	147
1,1-Dichloroethane	200 100(PEL)	250	NA		23	40.1	225
1,2-Dichloroethane	10 1(PEL)	2	100	No	54.0	79.7	186
Ethyl Benzene	100	125	0.092-0.6	Yes	83.7	105	225
Chloroform	10 2(PEL)	2	205-307	No	33.2	52.3	174
Methylene Chloride (Dichloromethane)	50	2,000	205-307	No	10.1	15.8	63.7
Trichloroethylene	50	200	50	Yes	55.3	83.0	195
Vinyl Chloride	5 1(PEL)	NA	260	No	0.009	0.016	0.070
Toluene	100	150	0.17	Yes	94.3	114	196
Xylene	100	150	0.05	Yes	98.7	116	193
Carbon Monoxide	50	400	NA	No	NA	NA	NA
Hydrogen Fluoride	3	6	NA	No	NA	NA	NA
Hydrogen Sulfide	10	15	NA	No	NA	NA	NA
Hydrogen Cyanide	NA	4.7	NA	No	NA	NA	NA
2,4-Toluene Diisocyanate	0.005	0.02	NA	No	NA	NA	NA

NA Information not available.  
-- No data.

<sup>1</sup> Threshold limit value, 8-hour time weighted average.  
<sup>2</sup> Short-term exposure limit, 15-minute time weighted average.  
<sup>3</sup> Permissible exposure limit.

## 5.0 Project Site Surveillance

Personal and area air monitoring are done to determine the level of hazardous substances to which Barr staff may be exposed. Monitoring is continued on a periodic basis to determine if an upgrade to air-purifying (Level C) or supplied-air (Level B) respiratory protection is necessary.

## 6.0 Training

All Barr staff who may need to use respiratory protection are trained in the proper use of respirators and their limitations during the initial hazardous waste-related operations training program. Barr staff who work in the laboratory area receive respirator training during their laboratory safety training. Additionally, all Barr staff receiving a respirator are trained on an individual basis when they are fit-tested in the Barr safety equipment room. Training provides the user the opportunity to:

- Handle the respirator.
- Have the respirator fit properly (qualitative fit-test). Conditions such as beard growth, sideburns and temple pieces on glasses for full facepiece respirator use may prevent a good face seal and cannot be worn by Barr staff using a respirator.
- Test the facepiece-to-face seal with a negative and positive pressure fit-test.
- Wear the respirator in normal air for a familiarity period.
- Wear the respirator in a test atmosphere that contains nontoxic irritant smoke.
- Be challenged, while wearing the respirator, with a test atmosphere by performing simple exercises and reciting the "Rainbow Passage."

This training also covers proper use of a respirator, assembly and breakdown of respirator parts, maintenance and repair, and proper storage procedures.

## 7.0 Proper Use of Respirators

There is a specific sequence of procedures that will be followed for good respirator fit. The procedure for putting on an air purifying respirator (donning), as well as the recommended removal procedure (doffing) of each respirator, is listed in this section. The procedures for donning and doffing SCBA/SAR respirators will be reviewed on a project basis.

Putting on the respirator:

- Visually inspect respirator for defects.
- Release straps to full open position.
- Holding respirator in one hand, place respirator to face so that the chin is inserted into chin cup of respirator. Fasten straps around neck.
- Push respirator up to face and hold it to face while each strap is pulled to tighten respirator, or while the top straps are fastened and tightened.
- Pull lower straps reasonably tight. Try to pull both sides of lower straps simultaneously.
- Pull top straps until snug.

- Straps should hold facepiece securely to face but should not be overly tight.
- Adjust facepiece for comfort and fit.
- Perform negative pressure test by placing hands over the intake valves and inhaling gently to determine whether air is leaking in around the facepiece.
- Perform positive pressure test by removing exhalation valve cap (MSA respirator only) and placing a hand or a piece of plastic over the exhalation valve and exhaling gently to determine if air is leaking out.
- Re-adjust facepiece, if necessary, until a good fit is made.

#### Removal of the respirator:

- The respirator exterior may be contaminated, so care should be exercised in removing it. A clean pair of surgical gloves should be worn while removing the respirator.
- The respirator is one of the last things to be removed when leaving the contaminated area.
- Release straps and pull respirator over head or away from face.
- Pull straps over respirator face shield to protect the lens (full facepiece only).
- Lay respirator so that it will not become contaminated inside and will not contaminate other things.
- Follow the cleaning/disinfecting procedure in Section 9.0 of this chapter.
- If the respirator is not cleaned at this time, it is placed in the designated "dirty" plastic bag and kept in the storage box to be cleaned at a later time. After it is cleaned, it is placed in the designated "clean" plastic bag.
- Alcohol wipes are included in the respirator boxes to clean the inside of the respirator, the sealing flange, and the outside of the respirator (in that order) between uses throughout the day.

Respirator filters or cartridges should be discarded after eight (8) hours of use or when breathing difficulty or breakthrough occurs.

## 8.0 Respirator Fit-Tests

All Barr staff in the hazardous waste-related operations safety program receive an initial fit-test prior to being issued an air purifying respirator. The respirator fit-test is performed annually/biannually thereafter. Barr staff who are not in the hazardous waste-related safety program receive a fit-test as needed.

### 8.1 Pretest Procedures

The following information describes the fit test procedures. The fit testing procedures will be performed by the equipment technician as follows:

- a) Assist the test subject in selecting an appropriately sized respirator. The subject should be asked to select the most comfortable respirator brand. Begin procedure using half-mask, then repeat for full facepiece respirator.
- b) Show the subject how to put on the respirator, properly position the straps, insert the respirator cartridges, and how to check for a proper fit. Specifically, the subject shall be shown how to conduct a positive and negative fit test.
- c) The subject should wear the selected mask for at least five minutes to assess the comfort of the mask.

- d) During the five minute assessment, the subject should be instructed to pay attention to:
  - Position of the mask on the nose
  - Room for eye protection (ask the subject to don glasses)
  - Room to talk
  - Position of the mask on face and cheeks
- e) The subject should be asked to look into the mirror and assess the following:
  - Chin properly placed
  - Adequate strap tension, not overly tightened
  - Fit across bridge of the nose (or temples for full facepiece)
  - Respirator of proper size to span distance from nose to chin (or temples to chin for full facepiece)
  - Tendency of respirator to slip

## 8.2 Respirator Fit Test Protocol

A qualitative air purifying respirator fit test, using irritant smoke to detect leaks in the facepiece-to-face seal, is given to assure a good fit. The air purifying respirator fit test procedure description follows.

- a) Have the subject perform positive and negative fit test. If either test is not successful, the subject should attempt to readjust the respirator (it should still fit comfortably but securely), and perform the positive and negative fit test again. If a satisfactory test cannot be performed, another respirator should be selected, and the pretest procedure repeated.
- b) Break both ends from a ventilation smoke tube and connect with flexible tubing to discharge port of a low flow air sampling pump, set to operate at 200 mL/min.
- c) With smoke tube approximately 12 inches from the subject's face, direct smoke toward the respirator facepiece. Ask the subject to breath normally. If the subject detects irritant smoke, discontinue test and either readjust respirator or select another size or brand of respirator. Note that some personnel will be unable to obtain a satisfactory fit with a half-mask respirator.
- d) Move smoke tube to within one inch of the edge of the respirator. While subject breathes normally, direct smoke around entire edge of the facepiece. If leakage is detected, readjust or select alternate respirator.
- e) Hold smoke tube a few inches from the subject's face. Ask the subject to:
  - Breath slowly and deeply for approximately one minute.
  - Nod head up and down slowly, for approximately one minute. Subject should inhale when head is fully up.
  - Turn head slowly from side to side, for approximately one minute. Head should be held momentarily at each side so subject can inhale when respirator is at extreme position on each side.
  - Count out loud backward from 100 to 0.
  - Smile and frown for 15 seconds.
  - Bend up and down at the waist as if they were touching their toes for approximately one minute.
  - Have subject breathe normally for one minute.
- f) If subject detects smoke at any time during procedure, discontinue the testing and select another respirator size or brand.

## 8.3 Post-Test Procedures

- a) Review with the subject:
  - Donning and doffing procedures
  - Reasons for respirator use, such as protection from known concentrations of identified air contaminants (gaseous and vapor phase contaminants should have good warning properties)
  - Limitations of air purifying respirators, such as: does not provide oxygen; limited duration of cartridges; for low contamination levels only; user must be clean shaven; must use appropriate cartridge
  - Cleaning, maintenance and storage of respirator
  - Where to obtain replacement respirators, cartridges, and filters
- b) The employee signs the Respirator Fit Test Record Form available from the Equipment Technician, and the person conducting the respirator fit test also signs the record form indicating that the employee successfully passed the fit test for that respirator type and size. The employee may be assigned a respirator of the same type and size along with a storage box with the appropriate accessories.

## 9.0 Respirator Maintenance/Repair

Barr staff should perform emergency respirator repair (e.g., valves, gaskets, etc.), on air purifying respirators only, as needed. The Equipment Maintenance Technician is available for nonemergency repairs, and to arrange for repair of air supplied respirators.

## 10.0 Respirator Cleaning/Sanitizing Procedure

Barr staff are responsible for cleaning/sanitizing their respirator facepieces after each use. The cleaning/sanitizing procedure for air purifying respirators is summarized in this section.

- Break down the respirator into its component parts.
- Discard the expended filters or cartridges.
- Discard head straps and valves if they are too contaminated to be cleaned or are no longer functional.
- Wash remaining parts in warm water with a mild detergent (MSA Cleaner-Sanitizer II, A33 Cleaning Powder, or similar). Scrub parts with a soft brush.
- Rinse.
- Air dry respirator in a clean area.
- Reassemble respirator.
- Place respirator in "clean" plastic bag, seal, and place in storage box.

Cleaning of air-supplied respirators should be restricted to wiping the interior and exterior of the facepiece with a damp cloth or disposable wipe. Additional cleaning should be left to the Equipment Maintenance Technician.

## 11.0 Storage

Each air-purifying respirator is assigned a number and stored in a numbered box. This box is kept on a shelf in the safety equipment room. The box contains: A33 cleaning powder for washing the respirator, alcohol wipes for midday use, a spare exhaust valve, two spare inhalation valves, two cartridge gaskets, a lens protector, a designated "dirty" plastic bag, a designated "clean" plastic bag, two spare HEPA cartridges, and two spare GMC-H cartridges. Respirators are stored in a plastic bag in their storage box, with the face shield facing up (full facepiece respirators only). SCBA respirators are numbered and stored in assigned storage/carrying cases.

## 12.0 Inspection

All SCBA/SAR respirators are inspected once a month by the Equipment Maintenance Technician. All respirators are inspected before each use by the employee that will be using the respirator. Respirators are also inspected during cleaning. Compressed air cylinders are checked to see they are fully charged according to the manufacturer's instructions. Respirator inspection includes a check on the condition of:

- Facepiece
- Headbands
- Valves
- Connecting tube
- Rubber or elastomer parts



Repairs on the air purifying respirators are done only with parts designated for the respirator by the manufacturer. Repairs on SCBA/SAR respirators are performed only by the manufacturer or certified repair service. Repair records are maintained in the safety equipment room. Records include inspection dates and comments on respirator maintenance.

### **13.0 Program Evaluation**

The effectiveness of the respirator program is evaluated annually through input from participating Barr staff. The effectiveness of the respirator program is also reviewed regularly by the Company Health and Safety Manager or designee.

### **14.0 Medical Surveillance**

Each Barr employee with 40-hour training covered by the Barr Health and Safety Policy Manual undergoes a physical exam and pulmonary function test prior to being issued a respirator. This physical exam and pulmonary function test evaluates the employee's ability to wear a respirator under conditions that may be expected at the project site. Medical surveillance for those Barr staff who occasionally wear a respirator is conducted as-needed.

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## Appendix F: Air Monitoring

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## Appendix F: Air Monitoring

### 1.0 Overview

Air monitoring is conducted to help verify that the level of protection selected is appropriate for different phases of the field operations. Real-time air monitoring using direct reading instruments is conducted based on the nature of site activities. Consideration for real-time air monitoring should be conducted when:

- site remediation begins,
- operations change,
- work begins on a different portion of the site,
- any intrusive site activity begins,
- contaminants other than those previously identified are being handled, or
- when obviously contaminated materials, leaking drums or containers are handled.

Air monitoring efforts are focused on those Barr employees conducting tasks representative of potential maximum exposure and on all employees likely to be exposed to any substance above the OSHA-Permissible Exposure Limit (PEL) or other published exposure level.

### 2.0 Monitoring Procedures

Two types of air monitoring are conducted, real-time and personal exposure monitoring. Real-time monitoring provides instant readout and is conducted for on-site screening for exposures to airborne levels of hazardous substances to determine the appropriate level of employee protection. Personal exposure monitoring involves collecting a sample for subsequent analysis and is conducted to quantify specific airborne concentrations of hazardous substances.

Monitoring is primarily conducted in the breathing zone. Monitoring also may be conducted at the source of potential contamination or at the point of intrusive activity. The breathing zone is an area within a 2-foot radius around the head. Information obtained from air monitoring is used to assure proper selection of engineering controls, personal protective levels, work zones, work practices, and to assure compliance with OSHA PELs and other published exposure levels.

### 3.0 Initial Entry

Prior to initial entry, a site history is obtained to determine potential contaminants that may be encountered and to assist in personal protective equipment and air monitoring equipment selection. During initial entry, real-time instruments may be used to monitor for those IDLH conditions that could potentially be encountered such as toxic, explosive, combustible and oxygen deficient atmospheres. When the site history indicates that ionizing radiation is suspected to be present, real-time instrumentation for determining levels of radiation are used, along with TLD badges to confirm personnel exposure. Additionally, visual observations are made continuously during the initial entry so that actual or potential IDLH conditions or other dangerous conditions can be noted for present and future use.

#### 4.0 Site Characterization

During site characterization, real-time monitoring is conducted where there is a reasonable possibility for exposure. Real-time monitoring is continued if the possibility of an IDLH or flammable atmosphere condition exists, or if there is an indication, based on initial entry monitoring, that exposures may approach action levels determined in the PHASP. Additionally, personal exposure monitoring is conducted when there is no suitable real-time instrument to monitor airborne levels of any of the hazardous substances anticipated.

During site characterization, periodic monitoring is conducted when:

- intrusive activities are conducted,
- work begins on a different portion of the site,
- when hazardous substances other than those identified during initial entry are being handled,
- a different type of operation is initiated, or
- when work is conducted in areas where hazardous substances are obviously present.

#### 5.0 Site Remediation

Periodic real-time and/or personal exposure monitoring is conducted throughout the remedial investigation phase and during the actual site remediation phase of a hazardous waste operation, when soil, water, waste, or containers which contain or are suspected to contain hazardous substances are moved or disturbed. The need for periodic real-time monitoring is listed in SECTION 1.0 of this Appendix. Personal exposure monitoring is conducted for Barr employees who are likely to have the highest exposures to hazardous substances. Personal exposure monitoring is also conducted when there is no suitable real-time instrument to monitor airborne levels of any of the hazardous substances anticipated.

The frequency of personal exposure monitoring will be sufficient to characterize employee exposure and to confirm selection of personal protective levels.

If the air monitoring results indicate airborne hazardous substances above the action levels established in the PHASP, the personal protective level will be upgraded to the indicated level and air monitoring continued. If the air monitoring results indicate that levels are below the action levels established in the PHASP, it may be determined that subsequent personal exposure monitoring is not required, and that the current personal employee protective level is sufficient to provide protection from potential exposure. Air monitoring results may be used to determine that personal employee protective level may be downgraded.

#### 6.0 Monitoring Equipment

Equipment operation and information is provided in SECTION 8.0 of this Appendix and is in accordance with the manufacturer's recommended operating procedures. Real-time monitoring equipment available at Barr's office are listed in TABLE F-1: TYPES OF REAL-TIME MONITORING EQUIPMENT.

Table F-1

## Types of Real-Time Monitoring Equipment

Combustible Gas Monitor:	MSA 260/360; MSA Microgard
Oxygen Detection Monitor:	MSA 260/360; MSA Microgard
Carbon Monoxide Monitor:	MSA 360
Organic Vapor Analyzer: Photoionization Detectors: Flame-ionization Detectors:	Thermo Environmental OVM 580B; HNU PI-101 and DL-101 Foxboro OVA 128 and 108
Detector Tube Pump	Drager/Sensidyne Pump With Chemical Specific Detector Tubes
Hydrogen Sulfide Monitor:	Industrial Scientific; HS267
Sulfur Dioxide Monitor:	Industrial Scientific; SO261
Real-Time Dust Monitor:	MIE Miniram; PDM-3

Personal exposure monitoring equipment consists of a calibrated portable Gillian/SKC air sample pump and compound specific filters/adsorbent tubes that are available from the Industrial Hygiene staff. Personal exposure monitoring for organic vapor may be performed through the use of a 3M 3500 organic vapor passive dosimeter monitor. When necessary, Barr field employees are issued a thermoluminescent dosimeter (TLD) badge that measures ionizing radiation exposure.

## 7.0 Air Monitoring Instrument Guidelines

### 7.1 Volatile Organic Compound Monitoring

Volatile organic compound monitoring may be required when:

- Volatile organic compounds are known or suspected to be present and previous monitoring has not been performed or has indicated VOC concentrations above background.
- An intrusive activity will be conducted where there is a **reasonable** possibility for inhalation exposure which may exceed a workplace exposure standard or IDLH concentrations.
- Periodic Monitoring Frequency:
  - Unusual or unidentified new odors are encountered.
  - Discolored soils are encountered.

### 7.2 Combustible Gas Monitoring

Combustible gas monitoring may be required when:

- Confined space entry.
- Excavation/trench entry.
- Intrusive activity at a landfill, intrusive activity when nature of hazardous substances present at site is unknown, and any intrusive activity when combustible gas may potentially have accumulated.

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- Periodic Monitoring Frequency:
  - The organic vapor monitor registers sustained readings above action level.
  - Intrusive activity when combustible gases may potentially have accumulated.
  - The potential exists for a combustible atmosphere to develop.

### 7.3 Particulate (aerosol) monitoring

Particulate (aerosol) monitoring may be required when:

- Hazardous substances are present at the ground surface and may become airborne as dust containing or suspected to contain hazardous substances.
- An intrusive activity will be conducted where there is a **reasonable** possibility for skin absorption, skin irritation, or eye irritation from airborne dust containing or suspected to contain hazardous substances.
- An intrusive activity will be conducted where there is a **reasonable** possibility for exposure to particulates which may exceed a workplace exposure standard or IDLH concentrations.
- Periodic Monitoring Frequency:
  - Large area(s) of material (soil) known or suspected to contain hazardous substances may become airborne from excavating trenching activities.
  - The potential exists for CTPVs to become airborne.

### 7.4 Detector Tubes

Detector tubes may be required when:

- Total organic vapor readout is equal to or exceeds the action limit for a 10-minute duration.
- An upgrade to Level C should be made until the VOCs of concern can be characterized with detector tubes, which may be used if outside temperature is 50°F or greater.
- If temperature is less than 50°F, the detector tubes become unreliable and should not be used to characterize VOCs.

### 7.5 Action Level Determination

A standard action level has been determined to protect against over exposure to organic vapors and airborne dust containing hazardous substances.

#### 7.5.1 Organic Vapors

An action level of 5 ppm total organic vapors for 10 minutes is generally considered adequate to maintain exposure levels lower than 50 percent of most TLVs, PELs or STELs (including benzene) of hazardous substances, whether monitoring with the HNU, OVA, or OVM. The specific action level for site operations is described in the PHASP.

## 7.5.2 Combustible Gases

An action level of 10 percent of the Lower Explosive Limit (LEL) is generally considered to be protective for exposure to a flammable atmosphere.

## 7.5.3 Total Dust

An action level of 5 mg/m<sup>3</sup> total dust (50 percent of nuisance dust TLV) will generally be more conservative than an action level determined for specific particulate compounds.

To determine if 5 mg/m<sup>3</sup> total dust is protective enough for the hazardous substance of concern, follow the procedure provided below:

1. Multiply the known fraction of the hazardous substance in the soil by the action level for total dust to determine what the airborne concentration of the hazardous substance would be at the dust action level assuming that all dust generated contains hazardous substances at that concentration. Compare with 50 percent of the TLV, PEL, or STEL (whichever is lowest). If the airborne concentration is lower, the action limit should remain 5 mg/m<sup>3</sup>.

**Example:**

The PEL for lead is 0.05 mg/m<sup>3</sup>. Fifty percent of the PEL is 0.025 mg/m<sup>3</sup>. If the concentration of the lead in the soil is 1,000 mg/kg (or ppm):

$$\frac{1000 \text{ mg Pb}}{10^6 \text{ mg soil}} \times \frac{5 \text{ mg soil}}{\text{m}^3 \text{ air}} = \frac{0.005 \text{ mg Pb}}{\text{m}^3 \text{ air}}$$

A comparison of 0.005 mg/m<sup>3</sup> airborne lead at the dust action level with the action level for lead (0.025 mg/m<sup>3</sup>) shows that the dust action level is protective to prevent lead exposure for soil containing 1,000 mg/kg of lead.

2. Alternatively, to determine a soil concentration of concern (i.e., the concentration corresponding with the hazardous substance's action level), divide the hazardous substance action level by the dust action level to determine the concentration of hazardous substance required in the soil to reach the action level.

**Example:**

$$0.025 \frac{\text{mg Pb}}{\text{m}^3 \text{ air}} \times \frac{\text{m}^3 \text{ air}}{5 \text{ mg soil}} = \frac{0.025 \text{ mg Pb}}{5 \text{ mg soil}} = 5000 \frac{\text{mg Pb}}{\text{kg soil}}$$

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## 8.0 General Maintenance and Calibration Information

Equipment maintenance and calibration records for air monitoring equipment are kept at Barr's office and are maintained by an Equipment Maintenance Technician. Any equipment that does not function appropriately is taken out of service and is made unavailable to Barr employees until the repair is made. Air monitoring equipment used on site is calibrated daily, or before each use if used less than daily. Calibration logs are to be kept in the Project Safety Diary or on the Daily Safety Report form. Instruction on calibration may be obtained from the Equipment Maintenance Technician.

## 9.0 Equipment Operation

The following discussion will describe manufacturer's information on the operation and limitations of instruments listed in TABLE F-1: TYPES OF REAL-TIME MONITORING EQUIPMENT. It should be noted that some of the monitoring equipment is affected by low oxygen levels and may not operate or readout accurately. Temperature use limitations also vary for the equipment. These particular limitations are listed in the specific discussions on each instrument.

### MSA 260/360 Combustible Gas Indicator/Oxygen Monitor/Carbon Monoxide Monitor (360)

CHEMICAL SUBSTANCES DETECTED:	Combustible vapors, (% Lower Explosive Limit - LEL) and oxygen concentrations (% O <sub>2</sub> ). In addition, MSA 360 detects carbon monoxide (ppm).
METHOD OF DETECTION:	Diffusion cell sensors
SCALE RANGES:	Combustible gas: 0% - 100% LEL Oxygen: 0% - 25% Carbon monoxide (360): 0-500 ppm
OPERATING TEMP. RANGE:	Combustible gas: 0°F to 104°F Oxygen: 0°F to 104°F (if calibrated at temp. of use)
SAMPLE FLOW RATE:	1.5 liters/min
RESPONSE TIME:	Combustible gas: 15 sec. to 90% final reading  Oxygen: 20 sec. to 90% final reading  Carbon monoxide (360): <5 sec. to alarm at 50 ppm
SPAN GAS:	Calibrated to methane (50% LEL), oxygen (15%) and carbon monoxide (60 ppm).
OPERATING TIME:	Up to 8 hours at room temperature (full charge). Low temperature will affect battery life.
ALARMS:	Combustible gas $\geq$ 10% LEL; audible, visual.  Carbon monoxide $\geq$ 50 ppm audible, visual.  MSA (360): <5 sec. to alarm at 50 ppm  Oxygen $\leq$ 19.5% or oxygen $\geq$ 23%; audible, visual.

NOTE: MSA 360 is intrinsically safe.

ALTITUDE: Oxygen sensor responds to partial pressure of oxygen in the atmosphere being tested. Therefore, changes in atmospheric pressure will alter the oxygen reading. Calibrate at elevation to be used.

BATTERY: Charge for at least 14 hours after 8 hours use (overnight).

THEORY OF OPERATION: Sample is pumped over a heated catalytic filament that forms part of a balanced electrical circuit. Combustibles are burned on the filament that raises its resistance in proportion to the combustibles in the sample. The resulting unbalance of the circuit causes a deflection of the metal pointer that indicates on the scale the concentration of combustible gases or vapors in the sample. The scale is graduated in percent of the LEL.

LIMITATIONS:

- Combustible gas indicator cannot be used in atmospheres with less than 10% oxygen, such as an inert gas background or furnace stack.
- Will not indicate the presence of combustible airborne mists or dusts such as lubricating oils, coal dust, or grain dust.

CAUTION:

- Silicone, silicates and organic lead compounds tend to "poison" the combustible gas sensor, thereby causing erroneously low readings. Calibration checks should be made frequently if such materials are suspected to be present in the tested atmosphere. Always use Inhibitor Filters to protect the sensor. They last for 8 hours of continuous testing.
- Avoid moist and humid conditions. Moisture may collect on the oxygen sensor. This could cause low oxygen readings and may shorten sensor life. Therefore, it is not recommended to use either the 260 or 360 for headspace testing.
- The oxygen sensor in the MSA 260/360 will accurately function down to 32°F. Use down to 0°F is possible, if it is calibrated at that temperature.

NOTE: Low temperature may shorten battery life.

MSA 260  
START-UP:

- \* Allow unit to climatize to operating temperature before start-up.
- 1. Turn function control to HORN OFF.
- 2. Allow unit to "warm up" for 5-10 minutes.
- 3. Set the % LEL meter to 0 using LEL zero adjust knob.
- 4. Set the % O<sub>2</sub> to 20.8 using O<sub>2</sub> calibrate adjust knob.
- 5. Press RESET button.
- 6. Turn FUNCTION control to ON.
- 7. Momentarily place a finger over the sample inlet fitting or the end of the sample line. Observe that the FLOW indicator float drops out of sight, indicating no flow. If it does not, check the flow system for leaks.
- 8. Instrument is ready for sampling.

\* These instructions appear on the inside top cover of the instrument.

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MSA 260/360 (continued)MSA 360  
START-UP:

1. Turn the FUNCTION control to the HORN OFF position. The HORN OFF lamp will light.
  2. Allow unit to "warm up" for 5-10 minutes.
  3. Set the readout to 00 by adjusting the LEL zero control (this must be done within 30 seconds of turning ON).
  4. Press the SELECT button firmly to get OXY to show in the readout, then set the readout to 20.8 by adjusting the OXY CALIBRATE control.
  5. Press the SELECT button firmly to get TOX to show in the readout, then set the readout to 00 by adjusting the TOX ZERO control.
  6. Press reset button.
  7. Turn the FUNCTION control to MANUAL for continuous read out of any one gas or to SCAN for automatic scanning of the three gas readings. (All alarm functions operate in either position.)
  8. Momentarily place a finger over the sample inlet fitting or the end of the sample line. Observe that the FLOW indicator float drops out of sight, indicating no flow. If it does not, check the flow system for leaks.
  9. Instrument is ready for sampling.
- \* These instructions appear on the inside top cover of the instrument.

MSA Microgard

CHEMICAL SUBSTANCES DETECTED:

Combustible vapors (% LEL) and oxygen concentration (% O<sub>2</sub>)

METHOD OF DETECTION:

Diffusion cell sensors

SCALE RANGES:

Combustible gas: 0% to 100% LEL  
Oxygen gas: 1% to 25%

OPERATING TEMP RANGE:

Combustible gas: 0°F - 120°F  
(when calibrated at temp of use)Oxygen gas: 0°F - 120°F  
(when calibrated at temp of use)**NOTE:** Low temp. may shorten battery life.

SAMPLE FLOW RATE:

Diffusion (w/Aspirator Pump .25 liter/min approx.)

RESPONSE TIME:

8 seconds to 90% final reading > 32°F  
3 minutes to 90% of final reading @ 0°F

OPERATING TIME:

Up to 8-10 hours at room temp. (full charge)

ALARMS:

Combustible gas  $\geq$  10% LEL; audible, visual  
Oxygen  $\leq$  19.5% or oxygen  $\geq$  23%; audible, visual

NOTE:

MSA Microgard is intrinsically safe.

ALTITUDE:

Change in altitude will alter oxygen reading. Calibrate at elevation to be used.

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MSA Microgard (continued)

## BATTERY:

Charge battery for 14-16 hours overnight (after 8 hours use).

## THEORY OF OPERATION:

Combustible gas sensor: Combustible gases in the sample combine with oxygen at the surface of the catalyzed detector "Pelement." Heat is liberated by this chemical reaction, increasing the temperature and the electrical resistance of the Pelement. This unbalances the bridge circuit, providing a voltage signal.

Oxygen sensor: The oxygen sensor is a galvanic type cell containing dissimilar metal electrodes in a special electrolyte. The cell is sealed with a membrane that allows oxygen to diffuse into the active area.

The current generated by the cell is proportional to the oxygen partial pressure in the atmospheric sample passing over the membrane face.

## LIMITATIONS:

- Combustible gas indicator cannot be used in atmospheres with less than 10% oxygen, such as an inert gas background or furnace stack.
- Will not indicate the presence of combustible airborne mists or dusts such as lubricating oils, coal dust, or grain dust.

CAUTION:

- Silicone, silicates and organic lead compounds tend to "poison" the combustible gas sensor, thereby causing erroneously low readings. Calibration checks should be made frequently if such materials are suspected to be present in the tested atmosphere.
- The oxygen sensor in the Microgard will accurately function down to 32°F. Use down to 0°F is possible, if it is calibrated at that temperature. SEE RESPONSE TIME.
- Avoid moist and humid conditions. Moisture may collect on the oxygen sensor. This could cause low oxygen readings and may shorten sensor life.
- If operating times are more than 8 hours per day, a second instrument may be required for use on alternate days to allow for adequate battery charging times.

## START-UP:

- \* Allow unit to "climatize" to operating temperature before start-up.
- 1. Press ON/OFF button (alarm will sound).
- 2. Wait for % LEL reading to stabilize and press RESET button. (This will shut off alarm.)
- 3. Open cover on right side of instrument and using the screwdriver supplied in carrying case set % LEL readout to 00 by adjusting the LEL zero control screw.
- 4. Press SELECT button firmly to get OXY readout then set the readout to 20.8 by adjusting the OXY's control screw.
- 5. Replace cover.
- 6. Instrument is ready for use.

HNU PI-101

CHEMICAL SUBSTANCES DETECTED: Organic Vapors with ionization potential  $\leq 10.2$  eV

METHOD OF DETECTION: Photo-ionization w/10.2 eV lamp

SCALE RANGE: 0.1 ppm to 2,000 ppm

OPERATING TEMP RANGE: 10°F to 104°F

SAMPLE FLOW RATE: 0.5 liters/min

RESPONSE TIME: Less than 3 seconds to 90% full-scale deflection.

CALIBRATION GAS: 100 ppm isobutylene (benzene reference).

METHANE DETECTION: Does not detect methane.

OPERATING TIME: Up to 10 hours (full charge).

ALARM: NO ALARM.

ALTITUDE: Readings not affected by altitude.

BATTERY: Charge for 14 hours after each day's use. 3 hours to 90% of full charge.

THEORY OF OPERATION: Molecules ionized by UV light forming ions that are collected on a charged plate. A current proportional to the number of ions is produced with a corresponding meter deflection.

## LIMITATIONS:

- Lamp has limited ionization potential.
- Low temperature shortens operating time of instrument (should accurately function to 10°F).
- Condensation on instrument window or polarizing electrode may cause loss in sensitivity and zero drift.
- Avoid extreme temperature changes.
- Avoid dusty or extremely humid atmospheres or areas with strong electromagnetic fields.
- Do not block exhaust port.

CAUTION:

## START-UP:

1. Connect wand.
2. Check battery.
3. Set to Standby.
4. Turn zero adjust until meter reads zero.
5. Check the responsiveness of the instrument:

With the scale on 0-2000 ppm, put a "magic marker" in front of the probe. Expect a reading in excess of 300 ppm.

Note: When not actively using the instrument, you can conserve the battery by leaving the setting on Standby.

Thermo-Environmental OVM Model 580B

CHEMICAL SUBSTANCES DETECTED: Organic Vapors with ionization potential  $\leq 10.6$  eV

METHOD OF DETECTION: Photo-ionization w/10.6 eV lamp

Thermo-Environmental OVM Model 580B (continued)

- SCALE RANGE: 0.1 ppm to 2,000 ppm
- OPERATING TEMP RANGE: 10°F to 104°F
- SAMPLE FLOW RATE: 0.5 liters/min
- RESPONSE TIME: Immediate (approximately 2 sec)
- CALIBRATION GAS: 250 ppm isobutylene (benzene reference)
- METHANE DETECTION: Does not detect methane.
- OPERATING TIME: Up to 8 hours (full charge).
- ALARM: 80 decibel audible alarm
- ALTITUDE: Readings not affected by altitude.
- BATTERY: Charge for 14 hours after each day's use.
- THEORY OF OPERATION: Molecules ionized by UV light form ions that are collected on a charged plate. A current, proportional to this ionization, is translated to a corresponding readout.
- LIMITATIONS:
- Lamp has limited ionization potential.
  - Low temperature shortens operating time of instrument and freezes LCD display (should accurately function to 10°F).
- CAUTION:
- Condensation on lamp window or polarizing electrode may cause loss in sensitivity and zero drift.
  - Avoid extreme temperature changes.
  - Avoid dusty or extremely humid atmospheres.
  - Do not block exhaust port.
  - Do not use in direct sunlight.
- INSTRUMENT START-UP:
1. Insert power plug.
  2. Press and hold "ON/OFF" key until pump starts.
  3. Wait for lamp to light (approximately 1 second).
- SELECT RUN MODE:
1. There are two lines of display. The top line shows run mode: MAX HOLD or CONCENTRATION METER (bar graph). Instrument will automatically display one or the other. Bottom line shows reading in parts per million (ppm). To change the run mode of the instrument press "mode/store" key. Display reads: LOG THIS VALUE?
  2. Press "-/crsr". Main menu will be displayed.
  3. Press "-/crsr" for parameters mode. Display reads: CONC. METER "RESET" TO CHG.
  4. Press "Reset". Display reads: MAX HOLD, + = USE / - = NO
  5. Press "+/inc" to use Max Hold or Press "-/crsr" to use Concentration Meter. Display reads: CONC. METER, "RESET" TO CHG.
  6. Press "Mode/Store" key to return to readout screen.

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Thermo-Environmental OVM Model 580B (continued)

7. Refer to Manual to make further revisions in modes of operation

## TO CHANGE INSTRUMENT MODE

From Main MenuSelect -/PARAM to:

Change run mode  
Set auto logging  
Set averaging interval  
Set alarm level  
Change lamp  
Select response factor  
Restore back-up calibration  
View free space

Select R/COMM to:

Display logged data  
Reset log to data

Select S/CLOCK to:

Update or confirm time and date

PLEASE REFER TO UNDERSIDE OF INSTRUMENT FOR  
QUICK START-UP FLOW CHART AND INSTRUCTIONS

Foxboro OVA 108, 128

## CHEMICAL SUBSTANCES DETECTED:

Organic vapors that can be ionized by a flame. Methane is detected by this instrument.

## METHOD OF DETECTION:

Flame ionization

## SCALE RANGE:

0-1,000 ppm (Model 128)  
0-10,000 ppm (Model 108)

## OPERATING TEMP RANGE:

32°F to 72°F  
Optimal flame ignition at room temperature.

## SAMPLE FLOW RATE:

2.0 liters/min @ 22°C

## RESPONSE TIME:

Approx. 2 seconds to 90% of final reading.

## CALIBRATION GAS:

Calibrated to methane (100 ppm).

## METHANE DETECTION:

Detects Methane. "Activated Carbon Filter" available that filters out all detectable vapors except methane.

## FUEL SUPPLY:

75cc tank of grade 5 Ultra Pure Hydrogen (99.999%). Max. pressure 2,400 psig.

## OPERATING TIME:

Up to 8 hours (full charge w/1,800 psig hydrogen tank)

## ALARMS:

Detection alarm user set to desired level. Flame out alarm indicates the flame has extinguished.

## NOTE:

OVA 108 and OVA 128 are intrinsically safe.

## ALTITUDE:

Readings not affected by altitude.

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Foxboro OVA 108, 128 (continued)

## BATTERY:

Should be on charge when not in use.

## THEORY OF OPERATION:

Combustion of an organic vapor by a hydrogen flame produces ions that are attracted to an electrode. A current is produced, amplified and a signal proportional to the amount of ions is translated to a meter reading.

## LIMITATIONS:

- Portability of hydrogen gas.
- Availability of refilling source.
- Warm-up time.
- Operating temp constraints (temperatures below 32°F may affect performance).

## CAUTION:

- Avoid dusty or extremely humid atmospheres.
- Do not block exhaust port.

## START-UP (OVA 108)\*:

1. Attach probe to readout assembly. Do not overtighten.
2. Move PUMP switch to ON and check battery condition with battery test switch.
3. Move INSTR switch to ON, allow five minutes for warmup.
4. Check calibration with HIGH and LOW calibration switch. End check by going to HIGH position and then off.
5. Place instrument panel in vertical position and check sample flow rate indication.
6. Open the H<sub>2</sub> tank valve, and the H<sub>2</sub> supply valve one full turn.
7. Depress igniter button until burner lights. Do not depress igniter button for more than six seconds. (If burner does not ignite, let instrument run for several minutes and again attempt ignition.)
8. Set alarm threshold knob on readout to desired level.
9. The instrument is now ready for use.

## SHUTDOWN (OVA 108)\*:

1. Close the H<sub>2</sub> supply valve and the H<sub>2</sub> tank valve.
  2. Move the INSTR switch and PUMP switch to OFF.
  3. Instrument is now in shut down configuration.
- \* These instructions appear on the inside of the cover of the instrument.

## START-UP (OVA 128)\*:

1. Attach probe to readout assembly. Do not overtighten.
2. Move PUMP switch to ON and check battery condition by moving the INSTR switch to the BATT position.
3. Move INSTR switch to ON and allow five minutes for warmup.
4. Set alarm level adjust knob on back of read out assembly to desired level.
5. Set calibrate switch to x10 position, use calibrate adjust knob and set meter to read zero.
6. Place instrument panel in vertical position and check sample flow rate indicator.

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Foxboro OVA 108, 128 (continued)

## SHUTDOWN (OVA 128)\*:

7. Open the H<sub>2</sub> tank valve and the H<sub>2</sub> supply valve.
8. Depress igniter button until burner lights. Do not depress igniter button for more than six seconds. (If burner does not ignite, let instrument run for several minutes and again attempt ignition.)
9. Use calibrate adjust knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set calibrate switch to x 1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with calibrate knob and make differential readings from there.

1. Close the H<sub>2</sub> supply valve and the H<sub>2</sub> tank valve.
2. Move the INSTR switch and the PUMP switch to OFF.
3. Instrument is now in shutdown configuration.

\* These instructions appear on the inside of the cover of the instrument

In addition to the instructions above:

1. Verify air-tight hose fit by blocking the end of the probe (i.e. with your finger).
2. Note the delivery pressure of the hydrogen, it should be constant between 9 and 10 psi.
3. Set the alarm level before igniting the instrument flame.
4. Select and record your "zero" before igniting the instrument flame. The instrument is typically "zeroed" to 1 ppm or 2 ppm so that the flame-out alarm does not sound without reason.
5. Check the functioning of the instrument: with the scale range at the highest setting (OVA 128), put a "magic marker" in front of the probe. Expect a reading in excess of 300 ppm.

Drager/Sensidyne Colorimetric Detector TubesCHEMICAL SUBSTANCES DETECTED:  
(tubes in stock)

Ammonia  
Benzene  
Carbon Dioxide

Carbon Monoxide  
Petroleum Hydrocarbons  
Vinyl Chloride

See ATTACHMENT F-1 for Data Sheets on: Benzene, Vinyl Chloride and Petroleum Hydrocarbons.

## METHOD OF DETECTION:

Colorimetric indication.

See individual data sheet for temperature constraints.

## SCALE RANGE:

Variable, according to manufacturer and chemical substance detected.

## OPERATING TEMPERATURE:

50°F - 104°F

## SAMPLE FLOW RATE:

Drager - 100 cm<sup>3</sup>/stroke  
Sensidyne - 100 ml/stroke

## RESPONSE TIME:

Variable, depends on specific detector tube.

## HUMIDITY:

20-90% humidity is acceptable.

Draeger/Sensidyne Colorimetric Detector Tubes (continued)

## THEORY OF OPERATION:

A known volume of contaminated air is drawn through a glass tube; the contaminant reacts with an indicator chemical in the tube, producing a stain whose length is proportional to the contaminant concentration.

## LIMITATIONS:

Accuracy and precision (+/- up to 35%). Slower response time in cold weather. Humidity and atmospheric pressure affects stain. Limited shelf life. Interferences by other chemical contaminants. Difficulty in "reading" stain endpoints. Long sampling time in some cases.

## CELSIUS CALCULATIONS:

10°C → 50°F

40°C → 104°F

0°C → 32°F

30°C → 86°F

°F = °C X 9/5 + 32

MSA 62S Combustible Gas Indicator

## CHEMICAL SUBSTANCES DETECTED:

% LEL

% Gas (methane)

## METHOD OF DETECTION:

Wheatstone Bridge

## SCALE RANGE:

0-100%

## OPERATING TEMP RANGE:

Do not operate over 125°F

## SAMPLE FLOW RATE:

0.8 to 1.4 liters/minute

## RESPONSE TIME:

Immediate

## CALIBRATION GAS:

99% Methane and 50% LEL Methane

## ALARMS:

None

## NOTE:

MSA 62S is intrinsically safe.

## BATTERY:

Uses eight Eveready 950 "D" cells.

Use the battery status indicator to check battery.

## ALTITUDE:

Calibrate at altitude in which the instrument will be used.

## THEORY OF OPERATIONS:

For Low Range Operation: The instrument contains a catalytic platinum filament which comprises one arm of a bridge circuit. When combustible gas in the atmosphere enters the catalytic filament well and makes contact with the catalyst on the surface of the filament, a combustible gas-oxygen reaction occurs, increasing the temperature of the filament. This increase in temperature causes an increase in filament resistance which unbalances the bridge. The resultant bridge signal voltage is read out on the meter as the % of the LEL.

For High Range Operation: To measure the concentration of combustible gas above the LEL of the mixture, a heated thermal conductivity (TC) filament, which comprises one arm of a second bridge circuit, is used. When combustible gas in the atmosphere enters the TC filament well and passes over the filament, it lowers the temperature of the filament. This decrease in temperature causes a decrease in filament resistance which unbalances the bridge. The resultant bridge signal is read out on the meter as the % of gas in the atmosphere.

MSA 62S Combustible Gas Indicator (continued)**LIMITATIONS:**

Combustible gas indicator cannot be used in atmospheres with less than 10% oxygen.

- Will not indicate the presence of combustible airborne mists or dusts.

**WARNING:**

Do not use a brass probe where shock hazards exist; that is, where contact may be made with electrical equipment or power lines. A high dielectric probe should be used in these areas.

**CAUTION:**

Sampling dusty or smokey atmospheres may clog the flow system. If either the speed of response of the instrument decreases or the aspirator bulb does not inflate within two seconds, check the flow system.

- Do not use the instrument at locations where compounds such as tetraethyl lead or hydraulic fluid or lubricants which contain silanes, silicates, or silicones may be present in the atmosphere. These chemicals contaminate the sensor.

**START UP:**

1. Open cover and set RANGE switch to LEL.
2. Set ON/OFF switch to ON. BATT indicator pointer should be well into white zone and the READY indicator should turn on within approximately 4 seconds. If it does not turn on, replace batteries (refer to SECTION 4).
3. Squeeze aspirator bulb 8 to 10 times to purge instrument with fresh air. Permit bulb to inflate completely after each squeeze. NOTE: If the bulb does not inflate within 2 seconds, check the flow system as described in SECTION 4.
4. Lift and adjust LEL ZERO control to obtain zero indication on meter. (To make zero adjustments, lift and turn outer sleeve ZERO controls.)
5. Set RANGE switch to GAS.
6. When READY indicator turns on, lift and adjust GAS ZERO control to obtain zero indication on meter.
7. In area to be tested, squeeze aspirator bulb seven to eight times to draw sample into instrument. When the needle stabilizes, the material indicates the concentration of the gas in air in percent by volume. NOTE: Meter indications are valid only when the READY indicator is on. (When using a sampling line, squeeze the aspirator bulb two additional times for each 10 feet of line. If a line trap is connected, squeeze the bulb four additional times.)
8. If the meter indicates less than 5, set RANGE switch to LEL and draw sample into instrument by squeezing aspirator bulb. The meter now indicates the percentage of the lower explosive limit (LEL) of the gas for which the instrument is calibrated. One of the following conditions may exist, depending on the deflection of the meter needle:
  - **Explosion hazard not present** - needle moves upscale slowly and comes to rest somewhere onscale (not near 100). Gas concentration below LEL. (Gas concentrations less than 100% of LEL support combustion, but do not propagate flame on contact with source of ignition.)
  - **Explosion hazard exists** - needle comes to rest near or at 100; gas concentration at LEL.

MSA 62S Combustible Gas Indicator (continued)

- **Explosion hazard exists** - needle deflects past 100 and remains offscale when aspirator bulb is squeezed; gas concentration above LEL and exceeds calibrated range of instrument.
- **Potential explosion hazard exists** - needle deflects rapidly above 100 and then deflects rapidly downscale. Gas concentration may be above explosive range; however, addition of air to gas/air mixture will create concentration in explosive range.

9. In atmosphere free of combustible gases, squeeze aspirator bulb 8 to 10 times to purge instrument with fresh air. Set ON/OFF switch to OFF or simply close cover.

Industrial Scientific HS267 Hydrogen Sulfide Monitor

CHEMICAL SUBSTANCES DETECTED:	Hydrogen sulfide (ppm)
METHOD OF DETECTION:	Electrochemical diffusion cell
SCALE RANGE:	1-1,999 (ppm)
OPERATING TEMP. RANGE:	0° to 104°F
RESPONSE TIME:	Less than 20 seconds to alarm when exposed to 25 ppm of hydrogen sulfide
SPAN GAS:	Hydrogen sulfide (25 ppm)
OPERATING TIME:	2,000 hours continuous (nonalarm)
ALARM:	10 ppm hydrogen sulfide, visual and audible
NOTE:	HS267 is intrinsically safe
BATTERY:	Four (4) "AA" alkaline
STARTUP:	<ol style="list-style-type: none"> <li>1. Back off the knurled nut that holds the calibration cover in place.</li> <li>2. Rotate the cover so that the metal button is inserted in the hole marked "S."</li> <li>3. Tighten the nut until the calibration cover is flush with the case. Do not overtighten.</li> <li>4. The monitor is ready for use as soon as the display stabilizes (approx. 60 seconds). Adjust "Z" screw to zero instrument, if necessary.</li> </ol>
SHUTDOWN:	<ol style="list-style-type: none"> <li>1. Back off the knurled nut that holds the calibration cover in place.</li> <li>2. Rotate the cover so that the metal button is inserted in the unmarked hole.</li> <li>3. Tighten the nut until the calibration cover is flush with the case. Do not overtighten.</li> <li>4. When the instrument is off, the printing on the calibration cover will be right side up.</li> </ol>

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Industrial Scientific SO261 Sulfur Dioxide Monitor

CHEMICAL SUBSTANCES DETECTED:	Sulfur dioxide (ppm)
METHOD OF DETECTION:	Electrochemical diffusion cell
SCALE RANGE:	0.1-200 ppm
OPERATING TEMP. RANGE:	-4°F to 104°F
RESPONSE TIME:	Less than 20 seconds to alarm (2 ppm) when exposed to 10 ppm of sulfur dioxide
SPAN GAS:	Sulfur dioxide (10 ppm)
OPERATING TIME:	2,000 hours continuous (nonalarm)
ALARM:	2 ppm sulfur dioxide, visual and audible
NOTE:	SO261 is intrinsically safe
BATTERY:	Four (4) "AA" alkaline
STARTUP:	<ol style="list-style-type: none"> <li>1. Back off the knurled nut that holds the calibration cover in place.</li> <li>2. Rotate the cover so that the metal button is inserted in the hole marked "S"</li> <li>3. Tighten the nut until the calibration cover is flush with the case. Do not overtighten.</li> <li>4. The monitor is ready for use as soon as the display stabilizes (approx. 60 seconds). Adjust "Z" screw to zero instrument, if necessary.</li> </ol>
SHUTDOWN:	<ol style="list-style-type: none"> <li>1. Back off the knurled nut that holds the calibration cover in place.</li> <li>2. Rotate the cover so that the metal button is inserted in the unmarked hole.</li> <li>3. Tighten the nut until the calibration cover is flush with the case. Do not overtighten.</li> <li>4. When the instrument is off, the printing on the calibration cover will be right side up.</li> </ol>

HNU DL101

CHEMICAL SUBSTANCES DETECTED:	Organic vapors with ionization potential $\leq 10.2$ eV (ppm)
METHOD OF DETECTION:	Photoionization with 10.2 eV lamp
SCALE RANGE:	0.1 to 2,000 ppm
OPERATING TEMP. RANGE:	To 40°C
SAMPLE FLOW RATE:	.225 liters/min.
RESPONSE TIME:	<3 sec. to 90% response
CALIBRATION GAS:	100 ppm isobutylene (benzene equivalent)
METHANE DETECTION:	Does <u>not</u> detect methane

HNU DL101 (continued)

OPERATING TIME:	>8 hours continuous use at 23°C Approx. 6.4 hours at 0°C
ALARM:	High and low alarm to be set according to application
ALTITUDE:	Not affected by altitude
BATTERY:	Low battery indicates there is approximately 20 min. left before unit shuts down. Recharge for 8-10 hrs. There is no danger of overcharging.
THEORY OF OPERATION:	Molecules ionized by UV light forming ions that are collected on a charged plate. A current proportional to the number of ions is produced with a corresponding meter readout.
LIMITATIONS:	<ul style="list-style-type: none"><li>• Lamp has limited ionization potential.</li><li>• Low temperature shortens operating time of instrument (should accurately function to 10°F).</li></ul>
CAUTION:	<ul style="list-style-type: none"><li>• Condensation on lamp window or polarizing electrode may cause loss in sensitivity and zero drift.</li><li>• Avoid extreme temperature changes.</li><li>• Avoid dusty or extremely humid atmospheres.</li><li>• Do not block exhaust port.</li></ul>
STARTUP:	<ol style="list-style-type: none"><li>1. Insert the probe connector into the receptacle on the right side of the control module (line up the red dots). The connector will "click" and lock in place.</li><li>2. Press and release the POWER button.</li><li>3. The pump is activated and the LCD shows: HNU Systems, Inc. 101 Datalogger, for 5-8 seconds while the unit is initializing and performing diagnostics. Electronic zero is also updated at this point.</li><li>4. The display then reverts to the operating screen. At this point, the instrument is in the survey mode, using the default calibration.</li></ol> <p>Place an open felt tip marker at the probe nozzle and check for reading above background.</p>

## 10.0 Exposure Monitoring Equipment

SKC-Gillian high and low flow pumps are used to collect personal/area exposure samples. TABLE F-2: SAMPLE PROTOCOLS lists the types of exposure samples which may be collected on site and a brief overview of sample/analysis procedures.

Table F-2  
Sample Protocols

Compound Sampled	Sample/Analytical Procedure	Sample Media	Flow Rate (L/Min.)	Sample Duration (Hrs.)
BETX <sup>1</sup>	NIOSH 1501	Charcoal tube	0.20	7 to 8
CTPVs <sup>2</sup>	OSHA 58	GF <sup>4</sup> Filter	2.0	7 to 8
Total Dust (Nuisance)	NIOSH 0500	PVC <sup>5</sup> Filter	1.5 to 2	7 to 8
Metals: Pb, As, Cd & Cr	NIOSH 7300	MCEF <sup>6</sup> Filter	1 to 4	7 to 8
Phenol	OSHA 32	XAD-7 Tube	0.1	4
Naphthalene	NIOSH 1501	Charcoal Tube	0.5	7 to 8
Pentachlorophenol	OSHA 39	XAD-7 Tube (treated)	0.2	4
PCBs <sup>3</sup>	NIOSH 5503	Florisil Tube	0.1	7 to 8
Vinyl Chloride	NIOSH 1007	Charcoal Tube	0.1	1
Indene	OSHA IMIS 1500	Chromozorb 106 Tube	0.175 to 0.200	7 to 8
1,2-dichloroethene	NIOSH 1015	Charcoal Tube	0.1	2 to 3
1,1,1-trichloromethane	NIOSH 1003	Charcoal Tube	0.1	2 to 3
BETX <sup>1</sup> & Naphthalene		3M 3500 Badge	0.025-0.050	8 to 10

<sup>1</sup> Benzene, ethyl benzene, toluene & xylene

<sup>2</sup> Coal tar pitch volatiles

<sup>3</sup> Polychlorobiphenyls

<sup>4</sup> Glass Fiber

<sup>5</sup> Polyvinyl chloride

<sup>6</sup> Cellulose ester membrane filter

*ATTACHMENT F-1*

AR307538



# Dräger Tube 67 28 561 Benzene 0.5/a

Instructions for Use 234-28561 e

4th Edition

May 1991

## Application Range

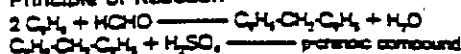
Determination of benzene in air or technical gases.

## Mode of Operation

The tube contains an ampoule with a colourless liquid, a white indicating layer and a pale brown colour comparison layer. Behind the comparison layer there is an additional sorption layer.

When air or a gas sample are sucked through the tube, the indicating layer changes colour to a pale brown in the presence of benzene.

## Principle of Reaction



## Ambient Conditions

- Temperature: 10°C to 40°C.
- Humidity: 3 to 15 mg/L (corresp. 65% rh. at 25°C).
- Atmospheric pressure: for correction of the reading, multiply by factor F.

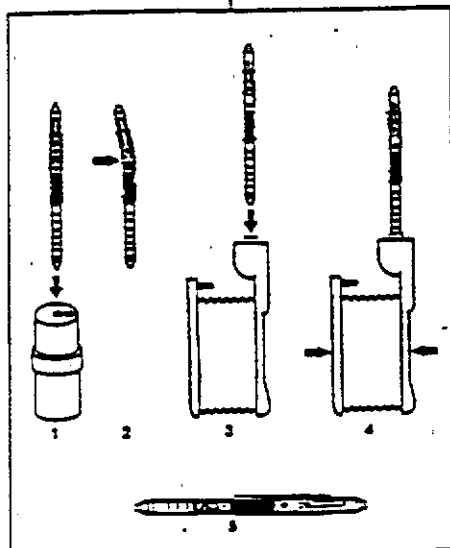
$$F = \frac{1013}{\text{actual atmospheric pressure (hPa)}}$$

## Prerequisites

- The tubes may only be used in conjunction with the Dräger Gas Detector Pump or the Dräger Quantimeter 1000, since otherwise considerable measurement errors are liable to occur.
- Observe the instructions for Use of the pump.
- Before each series of measurement, check the pump for leaks with an unopened tube.

## Measurement and Evaluation

1. Break off both tips of the tube in the tube opener.
2. Open the reagent ampoule by bending the tube by approx. 45° (the spot is marked by the two black dots). Tap the liquid onto the indicating layer until it is completely wetted.
3. Insert the tube tightly in the pump. Arrow points towards the pump.
4. Suck air or gas sample through the tube with an appropriate number of strokes, until the colour shade of the indicating layer corresponds to that of the colour-comparison layer. Do not effect more than 40 strokes. One stroke takes 15 to 30 seconds.
- Measuring range:  
0.5 to 10 ppm (2 to 40 strokes)



## 5. Evaluation of reading:

Strokes	2	3	4	7	10	20	25	30	40
Conc. (ppm)	10	7	5	3	2	1	0.8	0.7	0.5

- Multiply the value by factor F for correction of the atmospheric pressure. Enter the result in the measurement record.
- Relative standard deviation:  $\pm 30\%$ .
- Observe possible cross sensitivities.
- Flush the pump with air after operation.

## TLV (USA 1990): 10 ppm Benzene

1 ppm benzene = 326 mg benzene/m<sup>3</sup>

1 mg benzene/m<sup>3</sup> = 0.31 ppm benzene (at 20°C, 1013 hPa)

## Cross Sensitivities

- Other aromatics (toluene, xylene, ethyl benzene) are also indicated. Benzene measurement is not possible in such cases.
- Petroleum hydrocarbons, alcohols and esters do not interfere with the reading.

## Disposal

Avoid skin contact with the tube filling. Contents are corrosive. Keep out of reach for unauthorized persons. For disposal, observe safety recommendations S 2-26-30-36/37-44-51.

## Additional Information

The package strip indicates order number, shelf life, storage temperature and serial number. State the serial number for inquiries. Further information with respect to gas analysis with Dräger tubes will be submitted on request.

Attachment P-1

AR307539

# Dräger Tube Phenol 5/a

Instructions for use 234-216 e 12th Edition March 1985

## 1 General and Application

Measurement of phenol and its derivatives in air. Control of the degree of age-hardening of phenol condensations (smoke, varnish, etc.).  
The tubes are to be used in conjunction with the Dräger Gas Detector Pump. For use, see Section 4 of these instructions and instructions for Use -Gase Gas Detector.

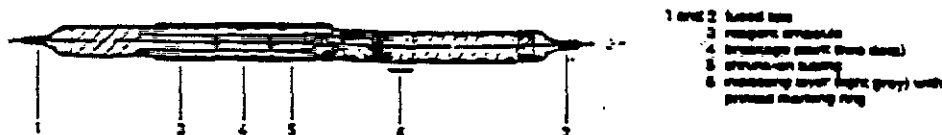
### Important:

It is not permissible to compare the tubes with results made by other manufacturers, since this may cause considerable errors in evaluation. Such a comparison would affect against relevant regulations.

## 2 Description

See illustration.

Coloring error: duration of one pump stroke and the test even is necessary (10: 7 to 14 strokes).



- 1 and 2 test area
- 3 response window
- 4 breakage point (two dots)
- 5 pressure-on tubing
- 6 indicating layer (light grey) with printed marking ring

23-234

## 3 Measuring Range (20°C, 1013 mbar)

When testing with 10 strokes, the indicating layer turns blue (test up to the printed marking ring with a concentration of 5 ppm).

## 4 Test and Evaluation of the Result

Break off the latest test. Crack the tube at the breakage point (marked with two black dots), allowing the response window to split. Gently shake the tube to spread the response at the division of the arrow. With 10 strokes of the pump, draw the air stream through the tube. The phenol concentration in the air is lower 5 ppm if the decoloration does not reach the red marking. The decoloration up to the red marking corresponds to 5 ppm.

With phenol concentrations of more than 5 ppm, the decoloration exceeds the red marking.

Note: Only the blue (test) decoloration points to phenol. Do not overstate the grey decoloration, since this is a leak result.

## 5 Remarks

Decolorations caused as result of phenol change with time.

## 6 Influence of the Ambient Conditions

The ambient temperature has no influence on measurement between 5 and 40°C. Water vapor causes the indicating layer to be decolorated pass point, but does not interfere with the printed indication.

## 7 Specificity

The reaction is based on the phenol blue reaction which is largely specific to phenol.

In addition to various phenol ( $C_6H_5OH$ ), all other phenols having a measurable vapour pressure are measured.

Some reacting substances (ammonia, amines) cause the indicating layer to be decolorated dark, but do not interfere with the phenol indication. Some organic compounds can cause the layer to be decolorated grey.

## 8 Shelf Life

See expiration date and storage temperature on label of the tube.

## 9 Toxicity Data

Threshold Limit Value (U.S.A.) 1987: 5 ppm.

1 ppm phenol = 2.57 mg/m<sup>3</sup>

1 mg/m<sup>3</sup> = 0.39 ppm

20°C, 1013 mbar

Our tube 4340 e contains in attachment order the gases and vapours measurable with Dräger tubes, important physical and toxicological data of the gases and vapours as well as many references to literature.

This tube will be sent to you on request.

## Caution

Do not allow used tubes to fall over the handle of children.

Contents are exhausted

Attachment F-1

AR307540

# Dräger Tube Toluene 5/a

Instructions for use 234-230a

18th Edition

April 1987

## 1 General and Application

Determination of toluene ( $C_6H_5CH_3$ ) in air.

The tubes are to be used in conjunction with the Dräger Gas Detector Pump.

For use, see Section 4 of these Operating Instructions and instructions for use 4341.

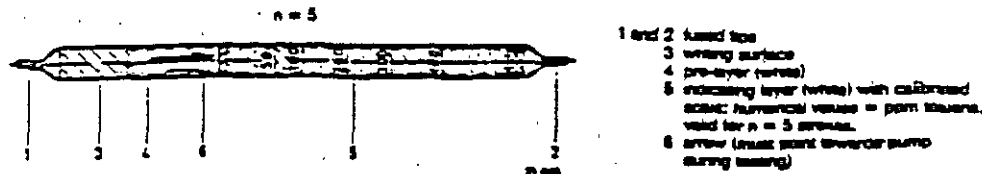
Important:

It is not permitted to combine the tubes with pumps made by other manufacturers, since this may cause considerable errors in indication. Such a combination would stand against relevant regulations.

## 2 Description

See illustration.

Operating time (duration of one pump stroke until the limit chain is completely shut): 10 to 20 seconds.



3 Range of measurement (20°C, 1013 mbar; corresponding to 20°C, 760 mm Hg)

With  $n = 5$  strokes: 5 to 400 ppm toluene

(The first scale division corresponds to 50 ppm,

smaller concentrations can only be estimated).

With  $n = 4$  strokes: Up to a maximum of 500 ppm toluene

(see Section 4.3)

1 ppm toluene  $\approx 3.84 \text{ mg/m}^3$   
1 mg toluene/m<sup>3</sup>  $\approx 0.26 \text{ ppm}$  } 20°C, 1013 mbar

## 4 Test and Evaluation of the Result

4.1 Before each series of measurements, test the pump for operation using an uncapped tube.

4.2 Break-off the tip of the tube.

4.3 Insert the tube tightly in the pump head (arrow points towards the pump).

4.4 Suck the air sample through the tube with 5 pump strokes. If toluene is present, the white indicating layer turns brown. The length of the coloration expresses about the concentration.

Numerical value = ppm toluene.

4.5 Measurements in the concentration range above 400 ppm.

Suck the air sample through the tube with 4 pump strokes. The indication (numerical value on the scale) multiplied by a factor of 1.25 gives ppm toluene.

## 5 Remarks

The detector must be tested for a few days if the tubes are sealed with rubber caps. The tubes cannot be used again even after a negative test result.

## 6 Influence of Ambient Conditions

### 6.1 Temperature

The tubes can be used in a temperature range of from +10°C to +30°C.

### 6.2 Humidity

Between 5 and 12 mg H<sub>2</sub>O per liter, humidity has no influence on the indication.

### 6.3 Atmospheric pressure

For pressure correction, multiply the tube reading by the following factor:

$$\text{Conversion factor} = \frac{1013}{\text{actual atmospheric pressure (in mbar)}}$$

## 7 Specificity (Cross-Sensitivity)

The indication is based on the reaction of toluene with iodic acid and sulphuric acid (colour change from white to brown).

Perseum hydrocarbons change the colour of the indicating layer to reddish-brown.

Benzene affects the indication only in concentrations above 150 ppm.

Benzene changes the colour of the indicating layer to a diffuse yellow. Xylenes are indicated with a lower sensitivity than toluene.

## 8 Shelf Life

See expiration date and storage temperature on label of the box.

## 9 Important Properties of Toluene

TLV (USA 1988):	100 ppm
Lower green limit:	1.2 vol. % (at 20°C)
Upper green limit:	7.0 vol. % (at 20°C)
Ignition temperature:	535°C
Flash point:	6°C
Vapour pressure:	22 mm Hg (at 20°C)
Viscosity (Saturation concentration in air):	111 mg/litre (at 20°C)
Molecular weight:	92.1
Density (liquid):	0.87 g/cm <sup>3</sup> (at 20°C)
Melting point:	-95°C
Boiling point:	111°C

## 10 Information

At the request of the tube user, we will supply the following information:

- The methods used for calibration of the detector tubes.
- The influence of test conditions (including reactions) on the course of the reaction and the reliability of the indication, provided that these effects are known to us.

## 11 Filter Protection

Should filter respiratory protection be necessary and acceptable, there with the code letter A should be used.

Our Table 4340e contains in alphabetical order the gases and vapours measurable with Dräger tubes, important physical and toxicological data of the gases and vapours as well as many references to literature.

The table will be sent to you on request.

## Caution

Do not allow used tubes to fall into the hands of children.

Copyright are reserved.

Attachment F-1

AR307541

# Dräger Tube o-Xylene 10/a

Instructions for Use 334-331818

3rd Edition

June 1988

## 1 General and application

Determination of o-xylene (1,2-dimethylbenzene) in air.

The tubes are to be used in conjunction with the Dräger Gas Detector Pump. For use, see Section 4 of these instructions and instructions for use of the Gas Detector Pump.

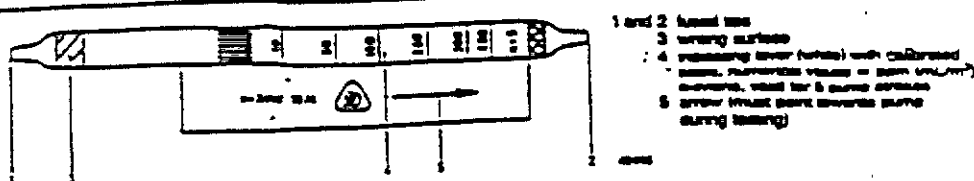
### Important:

It is not permissible to compare the tubes with tubes made by other manufacturers, since this may cause considerable errors in indication. Such a comparison would offend against relevant regulations.

## 2 Description

See illustration.

Operating time (duration of one pump stroke until the limit chain is automatically shut): 6 to 12 seconds.



3 Range of measurement (20°C, 1013 mbar)  
With n = 5 strokes 10 to 400 ppm (µL/L) o-xylene  
1 ppm (µL/L) o-xylene ≙ 4.44 mg/m<sup>3</sup> } 20°C, 1013 mbar  
1 mg o-xylene/m<sup>3</sup> ≙ 0.23 ppm

## 4 Test and evaluation of the result

4.1 Before each series of measurements, check the pump for leaks using an unopened tube.

4.2 Break off the tip of the tube.

4.3 Insert the tube lightly in the pump head. Arrow points towards the pump.

4.4 Suck the air sample through the tube with 5 pump strokes. o-Xylene turns the white indicating layer reddish brown. The total length of the discoloration is a measure of the o-xylene concentration.  
Numerical values in ppm (µL/L) o-xylene.

## 5 Remarks

The tube cannot be used again even after a negative test result. The discoloration lasts for a few days if the tube is sealed with rubber caps.

## 6 Influence of ambient conditions on the result of measurement

### 6.1 Temperature

The tubes can be used within a temperature range of from 0 to 40°C.

### 6.2 Humidity

Between 3 and 15 mg H<sub>2</sub>O per liter, humidity has no influence on the indication.

### 6.3 Atmospheric pressure

For pressure correction, multiply the tube reading by the following conversion factor:

$$\text{Conversion Factor} = \frac{1013}{\text{actual atmospheric pressure (in mbar)}}$$

## 7 Specificity (cross-sensitivity)

The o-xylene indication is based on the colour reaction with formaldehyde and sulphuric acid. m-Xylene and p-xylene are indicated with about the same sensitivity as o-xylene. In addition to o-xylene, other organic compounds are indicated. Some examples of the sensitivity of indication are:

- 100 ppm m-xylene give a reddish brown indication of app. 40
- 100 ppm p-xylene give a dark brown indication of app. 200
- 200 ppm ethyl benzene give a brown indication of app. 350
- 1000 ppm butadiene give a brown indication of app. 100.

No interference with the indication by, for example:

200 ppm methanol, 500 ppm n-octane, 400 ppm ethyl acetate.

## 8 Shelf life

For expiry date and storage temperature, see data on package strip.

## 9 Important properties of o-xylene

Threshold limit value (USA 1987): 100 ppm (435 mg/m<sup>3</sup>)

Chemical formula: C<sub>8</sub>H<sub>10</sub> (C<sub>6</sub>H<sub>4</sub>)<sub>2</sub>

Lower ignition limit:

1.5 vol. %

Upper ignition limit:

7.5 vol. %

Ignition temperature:

465°C

Vapour pressure:

8.7 mbar (20°C)

Volatility:

28 mg/L (20°C)

Flash point:

30°C

Molecular weight:

106.17

Density:

0.88 g/cm<sup>3</sup>

Melting point:

-25°C

Boiling point:

144°C

## 10 Information

At the request of the tube user, we will supply the following information:

- a) The methods used for calibration of the detector tubes.
- b) The effects (including responses) on the accuracy and accuracy of the gas detector tube are caused by specific environmental conditions described by the user, if these effects are known to us.

## Warning!

Do not carelessly discard used tubes so that they can fall into the hands of children! Containers are covered!

Attachment F

NR307542

**G/** Excavation Entry  
Procedures

AR307543

Appendix G: Excavation Entry Procedures

Table of Contents

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4.0	Excavation Entry Procedures	G-2
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6.0	Excavation Entry Checklist	G-5
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Figures

Figure G-1 Excavation Entry Decision Tree

Figure G-2 Excavation Entry Checklist

Attachments

Attachment G-1 OSHA Excavation Entry Standard

## Appendix G: Excavation Entry Procedures

## 1.0 Policy

It is Barr's policy that employees shall not enter any excavation for the purposes of investigation or construction observation without a clearly defined need and without specific authorization. Specific authorization for entry onto an excavation requires an evaluation, prior to each and every entry, by a Barr employee designated to be a Competent Person or an appropriately trained Barr employee to determine if the excavation is safe for entry.

## 2.0 Definitions

- 2.1 Excavation:** An excavation is any man-made cut, cavity, trench, or depression formed in the earth's surface by an earth removal or earth moving process. Any such cut, cavity, trench, or depression that is less than four (4) feet in depth or has side slopes of approximately 4H:1V or flatter shall not be considered an excavation regardless of depth.
- 2.2 Control of the Site:** The entity with control of the site has the authority to direct the activities of the workers that are performing the earth removal or earth moving operations. During typical site investigation activities involving one or more Barr subcontractors, Barr would be in control of the site. During typical construction observation activities involving one or more of the Owner's contractors, the contractor or Owner would be in control of the site. However, atypical contractual situations occur that may modify the control of the site for either investigation or construction observation activities.
- 2.3 Competent Person:** Competent Person means one who has experience and is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and has the authority to take prompt corrective measures, or to direct that prompt corrective measures be implemented, to eliminate the unsanitary, hazardous, or dangerous conditions. When Barr has control of the site, the Competent Person will be a designated Barr employee who meets the above criteria and has also received the training set forth in appropriately trained Barr employee. When Barr does not have control of the site, the Competent Person will be a designated Owner's employee or designated employee of Owner's contractor.
- 2.4 Appropriately Trained Barr Employee:** An appropriately trained Barr employee is that employee designated on project specific basis that has received training that includes:
- The requirements of these excavation entry procedures.
  - The requirements of the OSHA Excavation Entry Standard (29 CFR 1926.650).
  - Properties of soils and methods to classify soils in accordance with the requirements of 29 CFR 1926.650.
  - Construction methods including determination of inclination of side slopes and common uses of shoring, sheeting, trench boxes, benched excavations, and excavation machinery.
  - Construction site health and safety and the use of personal protective equipment and clothing.

An appropriately trained Barr employee is not, by definition, a Competent Person as defined previously.

- 2.5 Side Slopes:** Side slopes are those vertical or inclined earth surfaces formed as a result of the excavation work.

- 2.6 **Slopes 1.5H:1V or Flatter:** Side slopes that are sloped at an angle not steeper than one and one-half units horizontally to one unit vertically (34 degrees from horizontal).
- 2.7 **Slopes 4H:1V or Flatter:** Side slopes that are sloped at an angle not steeper than four units horizontally to one unit vertically (14 degrees from the horizontal).

### 3.0 Reporting of Excavation Entry Deficiencies

- 3.1 **Control of the Site by Barr:** Barr employees working with any Barr subcontractor conducting obviously deficient excavation entry practices should immediately direct the subcontractor's site supervisor or foreman to comply with the requirements of their contract and correct their excavation entry practices without delay and before proceeding with the work. Barr employees and Barr's subcontractor will not be authorized entry into the excavation until the identified deficiencies are corrected. After directing the subcontractor, Barr's employees shall also immediately report all deficient excavation entry practices by Barr's subcontractor to the Project Manager or Principal in Charge. Prior to going into the field, each Barr employee shall obtain from the Project Manager (PM) or Principal in Charge (PIC) a list of alternate PM's and PIC's to be contacted in the event that neither the Project Manager or Principal in Charge are available. The Barr employee shall also obtain a list of office and home phone numbers for the PM, PIC, and their alternates from the Health and Safety staff prior to leaving the office.

*The Project Manager, Principal in Charge, or their designated alternates shall determine whether the subcontractor's response to the Barr employee's direction has been adequate to correct the deficient excavation entry practices, or the subcontractor's work should be suspended until the subcontractor agrees, in writing, to correct the deficient conditions and acts to correct those conditions.*

- 3.2 **Control of the Site by Others:** Barr employees, serving as construction observers, should report any obviously deficient excavation entry practices immediately to the Project Manager, Principal in Charge, or their designated alternates. Prior to going into the field, each Barr employee shall obtain from the Project Manager (PM) or Principal in Charge (PIC) a list of alternate PM's and PIC's to be contacted in the event that neither the Project Manager or Principal in Charge are available. The Barr employee shall also obtain a list of office and home phone numbers for the PM, PIC, and their alternates from the Health and Safety staff prior to leaving the office. The Principal in Charge, or the designated alternate, after appropriate consultation with the Project Manager, will determine whether to call it to the attention of the owner's contractor, the owner, or both the owner and the owner's contractor.
- 3.3 **Unauthorized Excavation Entry by Barr Employees:** Any Barr employee observing another Barr employee entering an excavation without the authorization required by these Excavation Entry Procedures shall 1) immediately inform the other Barr employee that further entry should not occur until authorized and 2) immediately notify the Project Manager or Principal in Charge of the circumstances and identity of the employee involved. Repeated excavation entry, without the required authorization, by a Barr employee will be cause for appropriate disciplinary action by Barr.

### 4.0 Excavation Entry Procedures

No Barr employee shall consider entry into an excavation unless it has been clearly demonstrated that entry is necessary to perform a work task. Careful consideration and discussion should be given to developing alternative methods of accomplishing the work task without having to enter the excavation. Excavation entry should be considered to be the method of last choice for the performance of any specific work task. When and only when it is demonstrated that entry into an excavation is necessary to perform a work task



either the Project Manager and/or the Principal in Charge, or Barr's Competent Person on-site, agree that it is necessary to perform that work task, will the excavation entry procedures described below be implemented to authorize such excavation entry.

**4.1 Control of the Site by Barr:** The Competent Person may authorize excavation entry, whether by Barr employees, the employees of Barr's subcontractors, or anyone else including the Owner and representatives of any regulatory agency, only when:

- It has been demonstrated that excavation entry is necessary to perform a specific work task
- The Competent Person performs an inspection of the excavation
- The Competent Person completes the excavation entry checklist
- The Competent Person concludes that the excavation complies with the requirements of the OSHA Excavation Entry Standard (29 CFR 1926.650)

and then only by entering specific written authorization in the Project Safety Diary or on the Daily Safety Report Form.

Active excavations require inspection and authorization by the Competent Person prior to each and every entry to the excavation.

Inactive excavations require inspection and authorization by a Competent Person on at least a daily basis when entry to the excavation is necessary.

**4.2 Control of the Site by Others:** An appropriately trained Barr employee may authorize excavation entry by Barr employees only when:

- Entry is necessary to perform a work task.
- The appropriately trained Barr employee has met with the Competent Person representing the entity that has control of the site and said Competent Person has confirmed that in Competent Person's opinion the excavation complies with the requirements of OSHA Excavation Entry Standard (29 CFR 1926.650) for entry, and if the excavation is shored, shielded or benched the Competent Person has furnished the appropriately trained Barr employee with design drawings (prepared by and certified by a Registered Professional Engineer when required) of shoring, shielding, or benching.
- The appropriately trained Barr employee performs an inspection of any shielding, shoring, or benching, determines that shielding, shoring, or benching is in a good state of repair, and finds that the shielding, shoring, or benching conforms in all respects with drawings furnished by Competent Person.
- The appropriately trained Barr employee performs an inspection of the excavation.
- The appropriately trained Barr employee completes the excavation entry checklist.
- The appropriately trained Barr employee concludes that the excavation complies with the requirements of the OSHA Excavation Entry Standard (29 CFR 1926.650).
- Approval has been obtained from the Project Manager or Principal in Charge, after completing above items, and prior to each entry into an excavation. This prior approval is not required for most Wide Excavations and for inactive excavations for which the excavation entry checklist documents that there have been no changes in the conditions in the excavation.

The appropriately trained Barr employee should be prepared to discuss the reason that the entry is required and be able to describe the current conditions of the excavation.

## 5.0 Other Considerations

- 5.1 Hazardous Atmosphere:** If the excavation is being conducted in a hazardous atmosphere, or if the excavation is suspected to have the potential to create a hazardous atmosphere in the area adjacent to the excavation or in the excavation itself, monitoring of the atmosphere is required. Monitoring for toxic substances, oxygen content, and combustible gases will be conducted as required elsewhere in the PHASP.
- 5.2 Confined Space Entry Permit:** If there is a reasonable possibility that hazardous substances may be encountered during the entry to the excavation, a Confined Space Entry Permit, as described elsewhere in this PHASP, will also be required prior to entry.
- 5.3 Wide Excavations:** Certain excavations may be designated as a Wide Excavation upon inspection by an appropriately trained Barr employee or Competent Person. Wide Excavations have length and width dimensions such that there is a portion of the area within the limits of the excavation in which Barr employee may perform their work activities without further regard for excavation entry procedures. The area excluded from work activities should be at least at a distance of twice the height of the sloped portion which may not be appropriately sloped for safe entry. Wide Excavations will also have routes of ingress and egress which are on-grade or involve slopes not greater than 4H:1V that have been inspected by an appropriately trained Barr employee and are otherwise safe for entry according to the excavation entry checklist. The designation of a Wide Excavation should be documented by an appropriately trained Barr employee with specific written authorization in the Project Safety Diary or on the Daily Safety Report form.

The appropriately trained Barr employee designating the Wide Excavation shall also designate specifically those portions of such Wide Excavation which Barr employees cannot enter without fully complying with the excavation entry procedures under paragraph 4.0 above. The limits of the routes of ingress and egress and the area within which Barr employees may perform their work tasks, without regard for the excavation entry procedures, shall be delineated in the field using fencing, tape, lathe, spray paint, etc. or any combination thereof. Wide Excavations should be inspected at least daily by an appropriately trained Barr employee to verify that conditions within such Wide Excavation have not changed in a manner which requires a revision of any delineated limits. The delineation shall be maintained at least daily. The daily inspection and maintenance of delineated limits should be documented in the Project Safety Diary or on the Daily Safety Report form. No Barr employee may cross the delineated boundary of a Wide Excavation without fully complying with the excavation entry procedure (under paragraph 4.0 above).

- 5.4 Shielding:** A shield or shield system is a structure that is able to withstand the forces imposed on it by a cave-in. Shields can be permanent or portable to be moved along as the work progresses; shields can be premanufactured or job-built in accordance with 29 CFR 1926.652, (c)(3) or (c)(4). Shields used in trenches are commonly referred to as "trench boxes" or "trench shields." Shields must be suitable for the depth of excavation in which they are to be used; must be in good state of repair; must include all structural elements shown on detailed drawings, whether premanufactured or job-built; and should not be modified in any manner not shown on the detailed drawings. When control of the site is by Barr, no Barr employees, employees of Barr's subcontractors, representatives of the Owner, or representatives of regulatory agency shall be authorized to enter the excavation when a shield fails to meet these requirements or is for any reason deemed inadequate. When control of the site is by others, no Barr employees shall be authorized to enter the excavation when a shield fails to meet these requirements or is for any reason deemed inadequate.

- 5.5 Shoring:** Shoring is a structure such as a sheet pile, mechanical or timber system that supports the sides of an excavation and is designed to prevent cave-ins. Shoring must be in a good state of repair and must include all structural elements of the size and material shown on detailed drawings. When control of the site is by Barr, no Barr employees, employees of Barr's subcontractors, representatives of the Owner, or representatives of regulatory agency shall be authorized to enter the excavation when shoring fails to meet these requirements or is for any reason deemed inadequate. When control of the site is by others, no Barr employees shall be authorized to enter the excavation when shoring fails to meet these requirements or is for any reason deemed inadequate.
- 5.6 Benching:** Benching involves excavating the sides of an excavation to form a series of one or more horizontal levels or steps with vertical or slopes surfaces between levels. The requirements for benching will be determined on a case-by-case basis by Barr's Project Manager or Principal in Charge.
- 5.7 Excavations Over 20 Feet Deep:** Sloping, benching or shoring for excavations shall be designed and certified by a Professional Engineer registered in that state in which the excavation is being performed.
- 5.7.1 Control of the Site by Barr:** The sloping, benching, or shoring needs to be designed and certified by a Barr engineer (Registered Professional Engineer) or by a subconsultant retained by Barr (not by a Barr subcontractor) for the purpose of preparing and certifying the design. Further, Barr's representatives are obligated to continuously assure that the sloping, benching, or shoring is constructed in accordance with the design drawings and maintained so as to comply with the design drawings. No employee of Barr, any of Barr's subcontractors, or others including representatives of the Owner and regulatory agencies, shall be authorized entry to the excavation, under any circumstances whatsoever, unless the excavation complies with the design drawings (and all other requirements for excavation entry are met).
- 5.7.2 Control of the Site by Others:** The sloping, benching, or shoring needs to be designed and certified by a Registered Professional Engineer employed by or retained by the entity that has control of the site. No Barr employee may be authorized to enter the excavation until the excavation entry procedure described in paragraph 4.2 has been completed by the appropriately trained Barr employee on the site.

## 6.0 Excavation Entry Checklist

In addition to other requirements, an Excavation Entry Checklist must be completed prior to excavation entry. The Excavation Entry Checklist is presented in decision tree form in Figure G-1. An actual Excavation Entry Checklist will be of a form similar to Figure G-2. To assist in using the Excavation Entry Checklist when making the determination of whether to enter an excavation, the various elements of the checklist (and decision tree) are described in the following paragraphs.

- 6.1 Side Slopes 4H:1V or Flatter:** If any cut, cavity, trench, or depression formed in the earth's surface has side slopes of approximately 4H:1V or flatter it is not an excavation and the excavation entry checklist does not have to be completed before entry.
- 6.2 Less Than 4 Feet Deep:** If any cut, cavity, trench, or depression formed in the earth's surface has a depth of less than 4 feet it is not an excavation and the excavation entry checklist does not have to be completed before entry.
- 6.3 Hazardous Atmosphere:** Monitoring for toxic substances, oxygen content, and combustible gases will be conducted if a hazardous atmosphere is suspected.

- 6.4 **Complete CSE Permit:** A Confined Space Entry Permit is required for entry, if there is a reasonable possibility that hazardous substances may be encountered during entry.
- 6.5 **Control of the Site:** Barr personnel should obtain this information from the PM or PIC before going to the site. Control of the site does not affect only excavation entry.
- 6.6 **Confer with Competent Person:** The appropriately trained Barr employee has met with the Competent Person representing the entity that has control of the site and said Competent Person has confirmed that in Competent Person's opinion the excavation complies with the requirements of OSHA Excavation Entry Standard (29 CFR 1926.650) for entry.
- 6.7 **Obtain Drawings of Shielding, Shoring, or Benching:** If the excavation is sloped, shored, shielded, and/or benched the Competent Person representing the entity that has control of the site has furnished the appropriately trained Barr employee with design drawings (prepared by and certified by a Registered Professional Engineer when required by regulation or specification) of sloping, shoring, shielding, and/or benching.
- 6.8 **Less Than 20 Feet Deep:** Excavations that are less than 20 feet deep are not required to be designed by a Registered Professional Engineer. The excavation must, however, comply with the requirements of OSHA's Excavation Entry Standard before entry can be approved.
- 6.9 **Design by P.E.:** Sloping, shielding, benching, or shoring systems for excavations greater than 20 feet deep shall be designed by a Registered Professional Engineer (P.E.) in that state in which the excavation is located.
- 6.10 **Slopes 1.5H:1V or Flatter:** The side slopes of the excavation have to be sloped at an angle that is flatter than one and one-half horizontal to one vertical (34 degrees from horizontal).
- 6.11 **Soil Classified & Allowable Slope Documented:** Soils may be classified using the visual and manual soil classification methods described in the OSHA Excavation Entry Standard to determine the maximum allowable slope. Results of this classification and the allowable slope shall be documented in the Project Safety Diary or on the Daily Safety Report form.
- 6.12 **Inspect Sloping, Shielding, Shoring, and/or Benching:** Verify that sloped portions of the excavation are:
- 1.5H:1V or flatter
  - Flatter than the maximum allowable slope
  - Comply with the requirements of the Registered Professional Engineer's certified design

For those excavations that include shielding, shoring, and/or benching systems, verify that the shielding, shoring, and/or benching systems are in good state of repair and comply with the relevant drawings (certified by Registered Professional Engineer for excavations more than 20 feet deep).

Inspection must verify that all sloping, shielding, shoring, and/or benching systems conform to all requirements and details before excavation entry can be approved.

**6.13 Encumbrances Stabilized:** Any surface or subsurface obstruction located so as to create a hazard to employees must be removed, protected, or stabilized as necessary to make them safe before excavation entry can be approved.

**6.14 Good Egress Within 25 Feet:** In trench excavations, an easily-used, structurally-sound means of exit (stairway, ladder, ramp or other safe means) must be continuously provided within 25 feet of the work area before excavation can be approved.

**6.15 Protection From Falling Hazards:** Examples of falling hazards include:

- Loads handled by lifting or digging equipment
- Material falling from vehicles being loaded and unloaded
- Mobile equipment

Protective measures from falling hazards, such as:

- Prohibiting employees from being under loads handled by lifting and digging equipment
- Standing away from vehicles being loaded and unloaded
- Warning systems such as barricades
- Grading away from the excavation

Must be adopted or implemented before excavation entry can be approved.

**6.16 Protection From Accumulating Water:** Precautions that may be taken to protect employees from the hazards posed by water accumulation may include:

- Use of special support or shield systems (cave-in prevention)
- Availability of water removal systems for use in the event that water begins to enter into the excavation
- Use of water removal systems to control water or prevent water accumulations in the excavation

Must be provided for before excavation entry can be approved.

**6.17 Protection From Loose Rock and Soil:** Protection from loose rock, soil or other material or equipment that may fall or roll into the excavation from the excavation face or edge may consist of:

- Scaling to remove loose material
- Barricades on the excavation face
- Equipment kept at least two feet from excavation edge
- Retaining devices

The excavation must be safe from loose rock and soil before excavation entry can be approved.

**6.18 Excavation Complies:** The Barr's Competent Person on-site (when site is controlled by Barr) or the appropriately trained Barr employee (when site is controlled by others) concludes that the excavation complies with the requirements of the OSHA Excavation Entry Standard (29 CFR 1926.650).

- 6.19 **Confer With Barr's PM or PIC:** When the site is controlled by others, the appropriately trained Barr employee must confer Barr's Project Manager or Principal in Charge regarding the procedure followed and the appropriately trained Barr employee's observations and conclusions.
- 6.20 **Entry Approval by Barr's PM or PIC:** When the site is controlled by others, the appropriately trained Barr employee must receive specific approval to authorize each and every excavation entry from Barr's Project Manager or Principal in Charge.
- 6.21 **Barr's Competent Person On-Site Approves:** When the site is controlled by Barr, Barr's Competent Person on-site must specifically authorize each and every excavation entry.
- 6.22 **Procedure Documented in Writing:** The procedure followed, the conditions observed, and specific written authorization for the excavation entry must be entered in the Project Safety Diary or Daily Safety Report form prior to each excavation entry.

## 7.0 Training

Barr will provide training to employees regarding excavation and trench safety. This training includes, as a minimum:

- The requirements of the OSHA Excavation Entry Standard and this Excavation Entry Policy
- Construction site safety and personal protective equipment and clothing

In addition, Barr will provide additional training to employees to be designated as appropriately trained Barr employees or as a Competent Person. This training includes, as a minimum:

- Properties of soils and methods to classify soils in accordance with the requirements of the OSHA Excavation Entry Standard
- Construction methods including common uses of shielding (such as trench boxes), shoring, benching, and excavation machinery

## 8.0 OSHA Excavation Entry Standard

The OSHA Excavation Entry Standard (ATTACHMENT G-1) contains information on:

- Soil Classification
- Sloping and Benching
- Selection of Protection System

This standard, OSHA Excavation Entry Standard, should be referred to prior to excavation entry.

*FIGURE G-1*

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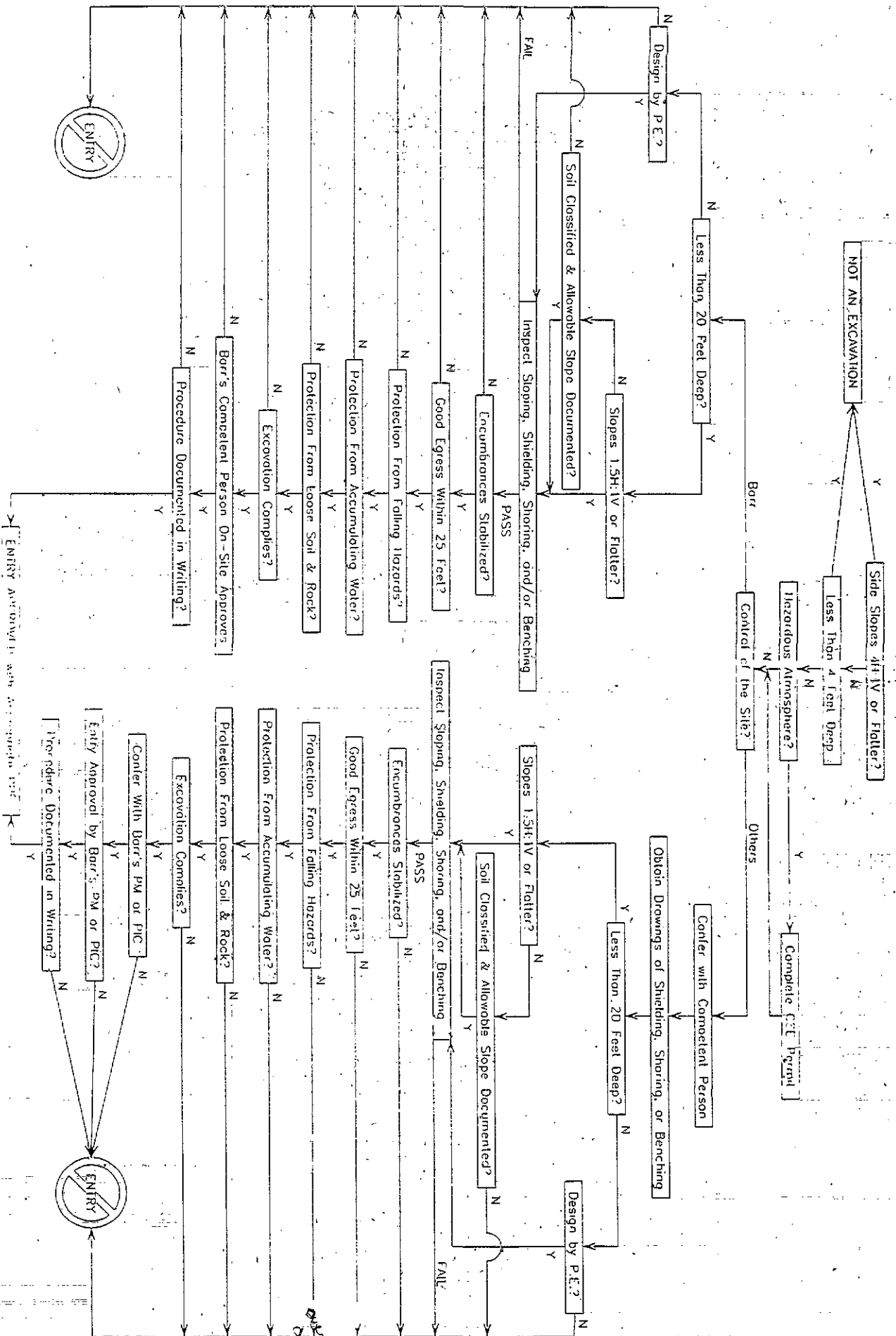


FIGURE G-1 EXCAVATION ENTRY DECISION TREE

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FIGURE G-2

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**Figure G-2**  
**Excavation Entry Checklist**

Project Name & Number \_\_\_\_\_ Date \_\_\_\_\_

Checklist completed by \_\_\_\_\_ Competent Person \_\_\_\_\_ Approp. Trained Barr Employee \_\_\_\_\_

1. Excavation entry is necessary to perform work task? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
2. Are sides slopes 4H:1V or flatter? Yes\_\_\_ No\_\_\_ If yes, checklist not required to perform work task.
3. Is excavation less than 4 feet deep? Yes\_\_\_ No\_\_\_ If yes, checklist not required to perform work task.
4. Is there a known hazardous atmosphere or suspected potential to create hazardous atmosphere?  
Yes\_\_\_ No\_\_\_ If no, skip to line 6.
5. Complete Confined Space Entry (CSE) Permit before continuing checklist. Attach field copy of permit.
6. Who has control of the site? Barr\_\_\_ Others\_\_\_ If Barr, skip to line 9.
7. Does Competent Person confirm that in Competent Person's opinion the excavation complies with OSHA Excavation Entry Standard (29 CFR 1926.650)? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
8. Has Competent Person provided you with drawings of shielding, shoring, and/or benching being used?  
Yes\_\_\_ No\_\_\_ If no, skip to line 26.
9. Is excavation less than 20 feet deep? Yes\_\_\_ No\_\_\_ If no, skip to line 12.
10. Are the side slopes 1.5H:1V or flatter? Yes\_\_\_ No\_\_\_ If yes, skip to line 13.
11. Have the soil been classified and the allowable side slope been determined in accordance with the OSHA Excavation Entry Standard (29 CFR 1926.650) and documented? Yes\_\_\_ No\_\_\_ If no, either perform the classification, determination, and documentation or skip to line 26. If yes, skip to line 13.
12. Has excavation been designed and certified by a Registered Professional Engineer and do you possess copies of the certified design drawings? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
13. Has the sloping, shielding, shoring and/or benching been inspected and found to be in good state of repair and found to conform in every detail to the certified design drawings or other drawings (if more than 20 feet deep)?  
Pass\_\_\_ Fail\_\_\_ If fail, skip to line 26.
14. Have encumbrances such as any surface or subsurface obstruction located so as to create a hazard to employees been removed, protected, or stabilized as necessary to make them safe? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
15. Is good egress, such as stairway, ladder, ramp, or other safe means, located within 25 feet of the work area? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
16. Have protective measure from falling hazards been adopted or implemented? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
17. Have precautions been taken to protect employees from the hazards of water accumulation been provided? Yes\_\_\_ No\_\_\_ If no, skip to line 26.

18. Have adequate measures been taken to protect from loose rock, soil, or other material or equipment that may fall or roll from the face or edge of the excavation? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
19. Can it be concluded that the excavation complies with the requirements of OSHA's Excavation Entry Standard (29 CFR 1926.650)? Yes\_\_\_ No\_\_\_ If no, skip to line 26.

If site is controlled by others (see line 6), skip to line 22.

20. Has Barr's Competent Person on-site given approval for the excavation entry? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
21. Have the procedure followed, the conditions observed, and the specific authorization for the excavation entry been documented in the Project Safety Diary or Daily Safety Report form? Yes\_\_\_ No\_\_\_ If no, skip to line 26. If yes, skip to line 25.
22. Have you conferred with Barr's Project Manager or the Principal in Charge regarding your observations and conclusions and the need to enter excavation? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
23. Has Barr's Project Manager or the Principal in Charge given their approval for the excavation entry? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
24. Have the procedure followed, the conditions observed, and the specific authorization for the excavation entry been documented in the Project Safety Diary or Daily Safety Report form? Yes\_\_\_ No\_\_\_ If no, skip to line 26.
25. Excavation entry is APPROVED consistent with the PHASP requirements such as appropriate personal protection equipment (PPE). Checklist complete.
26. Excavation entry is NOT approved and under no circumstances shall the excavation be entered by
- a. Any Barr employee, employee of Barr's subcontractor(s), or others such as representatives of Owner or MPCA where the site is controlled by Barr;
  - b. Any Barr employee where the site is controlled by others.

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

*ATTACHMENT G-1*

AR307558

## PART 1926—[AMENDED]

## Subpart M—[Amended]

1. By revising the authority citation for subpart M of part 1926 to read as follows:

Authority: Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8734), 8-78 (41 FR 25059), or 9-83 (48 FR 35736), as applicable, and 29 CFR part 1911.

2. By revising subpart P of part 1926 to read as follows:

## Subpart P—Excavations

## Sec.

1926.650 Scope, application, and definitions applicable to this subpart.

1926.651 General requirements.

1926.652 Requirements for protective systems.

## Appendix A to Subpart P—Soil Classification

## Appendix B to Subpart P—Sloping and Benching

## Appendix C to Subpart P—Timber Shoring for Trenches

## Appendix D to Subpart P—Aluminum Hydraulic Shoring for Trenches

## Appendix E to Subpart P—Alternatives to Timber Shoring

## Appendix F to Subpart P—Selection of Protective Systems

## Subpart P—Excavations

Authority: Sec. 107, Contract Worker Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8734), 8-78 (41 FR 25059), or 9-83 (48 FR 35736), as applicable, and 29 CFR part 1911.

§ 1926.650 Scope, application, and definitions applicable to this subpart.

(a) *Scope and application.* This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

(b) *Definitions applicable to this subpart.*

*Accepted engineering practices* means those requirements which are compatible with standards of practice required by a registered professional engineer.

*Aluminum Hydraulic Shoring* means a pre-engineered shoring system, comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (walers). Such system is designed, specifically to support the

sidewalls of an excavation and prevent cave-ins.

*Bell-bottom pier hole* means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

*Benching* (Benching system) means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

*Cave-in* means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

*Competent person* means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

*Cross braces* mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

*Excavation* means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

*Faces or sides* means the vertical or inclined earth surfaces formed as a result of excavation work.

*Failure* means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

*Hazardous atmosphere* means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

*Kickout* means the accidental release or failure of a cross brace.

*Protective system* means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

*Ramp* means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from

structural materials such as steel or wood.

*Registered Professional Engineer* means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

*Sheeting* means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

*Shield* (Shield system) means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with § 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

*Shoring* (Shoring system) means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

*Sides.* See "Faces."

*Sloping* (Sloping system) means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

*Stable rock* means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

*Structural ramp* means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

*Support system* means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground

installation, or the sides of an excavation.

**Tabulated data** means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

**Trench** (Trench excavation) means a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

**Trench box.** See "Shield."

**Trench shield.** See "Shield."

**Uprights** means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

**Wales** means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

#### § 1926.851 General requirements.

(a) **Surface encumbrances.** All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

(b) **Underground installations.** (1) The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

(2) Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other

acceptable means to locate utility installations are used.

(3) When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

(4) While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

(c) **Access and egress—(1) Structural ramps.** (i) Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

(ii) Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

(iii) Structural members used for ramps and runways shall be of uniform thickness.

(iv) Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

(v) Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

(2) **Means of egress from trench excavations.** A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

(d) **Exposure to vehicular traffic.** Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

(e) **Exposure to falling loads.** No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with § 1926.801(b)(6), to provide adequate protection for the operator during loading and unloading operations.

(f) **Warning system for mobile equipment.** When mobile equipment is operated adjacent to an excavation, or

when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

(g) **Hazardous atmospheres—(1) Testing and controls.** In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50–1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

(i) Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

(ii) Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

(iii) Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

(iv) When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

(2) **Emergency rescue equipment.** (i) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

(ii) Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a life-line securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually

attended at all times while the employee wearing the lifeline is in the excavation.

(h) *Protection from hazards associated with water accumulation.* (1) Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

(2) If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

(3) If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

(i) *Stability of adjacent structures.* (1) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

(2) Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

(i) A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

(ii) The excavation is in stable rock; or

(iii) A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

(iv) A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

(3) Sidewalks, pavements, and appurtenant structure shall not be undermined unless a support system or another method of protection is

provided to protect employees from the possible collapse of such structures.

(j) *Protection of employees from loose rock or soil.* (1) Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of scaling to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

(2) Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

(k) *Inspections.* (1) Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

(2) Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

(l) *Fall protection.* (1) Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.

(2) Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.

§ 1926.652 Requirements for protective systems.

(a) *Protection of employees in excavations.* (1) Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

(i) Excavations are made entirely in stable rock; or

(ii) Excavations are less than 5 feet (1.52m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

(2) Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

(b) *Design of sloping and benching systems.* The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3), or, in the alternative, paragraph (b)(4), as follows:

(1) *Option (1)—Allowable configurations and slopes.* (i) Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

(ii) Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this subpart.

(2) *Option (2)—Determination of slopes and configurations using Appendices A and B.* Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of sloping or benching systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and shall include all of the following:

(A) Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;

(B) Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include at least the following:

(A) The magnitude of the slopes that were determined to be safe for the particular project.

(B) The configurations that were determined to be safe for the particular project and.

(C) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time the design need not be at the jobsite, but a copy shall be made available to the Secretary upon request.

(c) *Design of support systems, shield systems, and other protective systems.* Designs of support systems, shield systems, and other protective systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

(1) *Option (1)—Designs using appendices A, C and D.* Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

(2) *Option (2)—Designs Using Manufacturer's Tabulated Data.* (i) Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

(ii) Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval.

(iii) Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the jobsite during construction of the protective system. After that time this data may be stored off the jobsite, but a copy shall be made available to the Secretary upon request.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and include all of the following:

(A) Identification of the parameters that affect the selection of a protective system drawn from such data;

(B) Identification of the limits of use of the data;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include the following:

(A) A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

(B) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, but a copy of the design shall be made available to the Secretary upon request.

(d) *Materials and equipment.* (1) Materials and equipment used for protective systems shall be free from

damage or defects that might impair their proper function.

(2) Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

(3) When material or equipment that is used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

(e) *Installation and removal of support.* (1) *General.* (i) Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.

(ii) Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

(iii) Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

(iv) Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

(v) Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

(vi) Backfilling shall progress together with the removal of support systems from excavations.

(2) *Additional requirements for support systems for trench excavations.*

(i) Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.



(ii) Installation of a support system shall be closely coordinated with the excavation of trenches.

(f) *Sloping and benching systems.* Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

(g) *Shield systems—(1) General.* (i) Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(ii) Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(iii) Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(2) *Additional requirement for shield systems used in trench excavations.* Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

#### Appendix A to Subpart P

##### Soil Classification

(a) *Scope and application—(1) Scope.* This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) *Application.* This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in § 1926.852(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in § 1926.852(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) *Definitions.* The definitions and examples given below are based on, in whole or in part, the following: American Society for

Testing Materials (ASTM) Standards D653-85 and D2485; The Unified Soils Classification System. The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS-121.

*Cemented soil* means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

*Cohesive soil* means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

*Dry soil* means soil that does not exhibit visible signs of moisture content.

*Fissured* means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

*Granular soil* means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

*Layered system* means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

*Moist soil* means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

*Plastic* means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

*Saturated soil* means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or shear vane.

*Soil classification system* means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

*Stable rock* means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

*Submerged soil* means soil which is underwater or is free seeping.

*Type A* means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some

cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

- (i) The soil is fissured; or
- (ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
- (iii) The soil has been previously disturbed; or
- (iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or
- (v) The material is subject to other factors that would require it to be classified as a less stable material.

##### Type B means:

- (i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or
- (ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
- (iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

- (v) Dry rock that is not stable; or
- (vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

##### Type C means:

- (i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
- (ii) Granular soils including gravel, sand, and loamy sand; or
- (iii) Submerged soil or soil from which water is freely seeping; or
- (iv) Submerged rock that is not stable; or
- (v) Material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper.

*Unconfined compressive strength* means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

*Wet soil* means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) *Requirements—(1) Classification of soil and rock deposits.* Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) *Basis of classification.* The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses

shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those accepted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

(3) *Visual and manual analyses.* The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

(4) *Layered systems.* In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

(5) *Reclassification.* If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) *Acceptable visual and manual tests.*—

(1) *Visual tests.* Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spill off a vertical side, the soil could be fissured. Small spills are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) *Manual tests.* Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) *Plasticity.* Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of 1/8-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) *Dry strength.* If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) *Thumb penetration.* The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2486—"Standard Recommended Practice for Description of Soils (Visual—Manual Procedure).") Type A soils with an unconfined compressive strength of 1.5 tsi can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsi can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shear vane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as a unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a

granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the soil is granular.

## Appendix B to Subpart P

### Sloping and Benching

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in § 1926.652(b)(2).

#### (b) Definitions.

*Actual slope* means the slope to which an excavation face is excavated.

*Distress* means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and ravelling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

*Maximum allowable slope* means the steepest incline of an excavation face acceptable for the most favorable site conditions as protection against cave-ins and is expressed as the ratio of horizontal distance to vertical rise (H:V).

*Short term exposure* means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements.*—(1) *Soil classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slope.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B-1 of this appendix.

(3) *Actual slope.* (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least 1/4 horizontal to one vertical (1/4H:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with § 1926.651(i).

(4) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B-1.

TABLE B-1  
MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK TYPE A [2] TYPE B TYPE C	VERTICAL (90°) 3/4 : 1 (53°) 1:1 (45°) 1½ : 1 (34°)

NOTES:

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

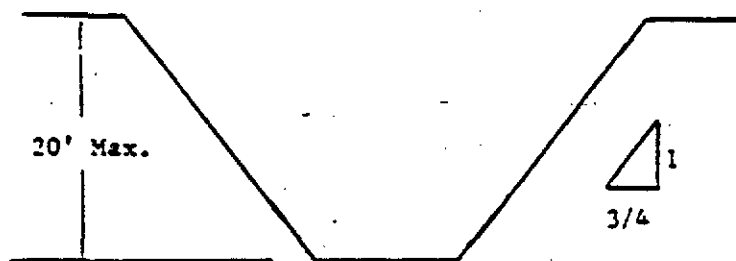
Figure B-

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

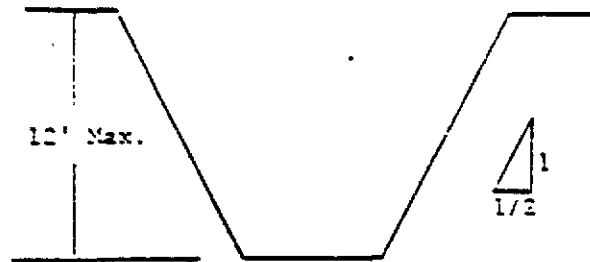
B-1.1 Excavations made in Type A soil

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1.



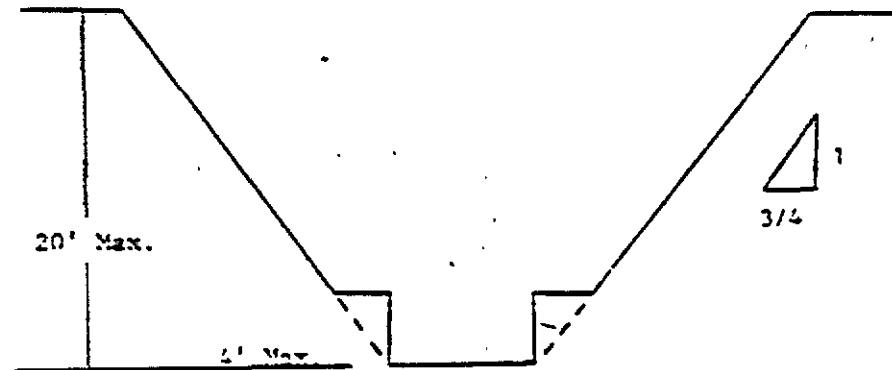
Simple Slope—General

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of ¾:1.

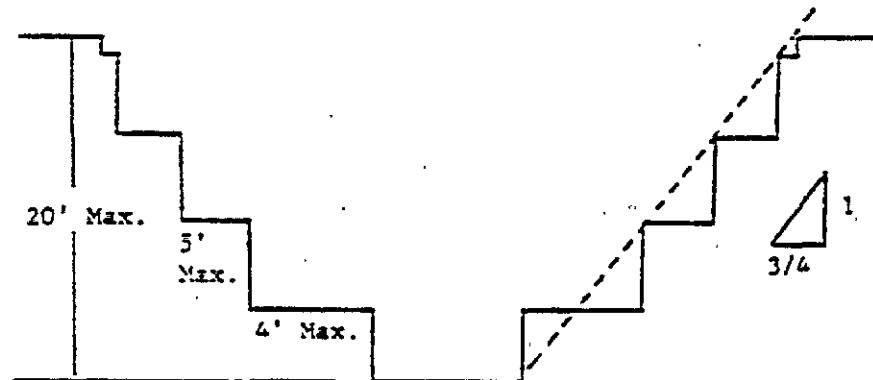


**Simple Slope—Short Term**

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of  $\frac{3}{4}$  to 1 and maximum bench dimensions as follows:

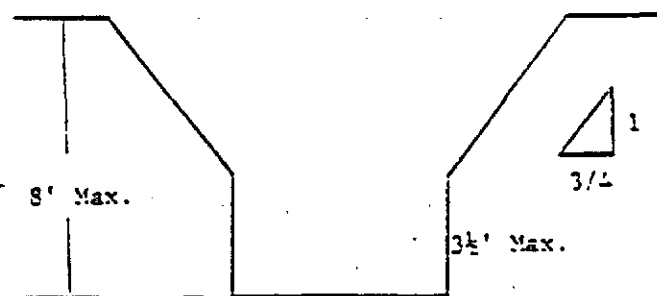


**Simple Bench**



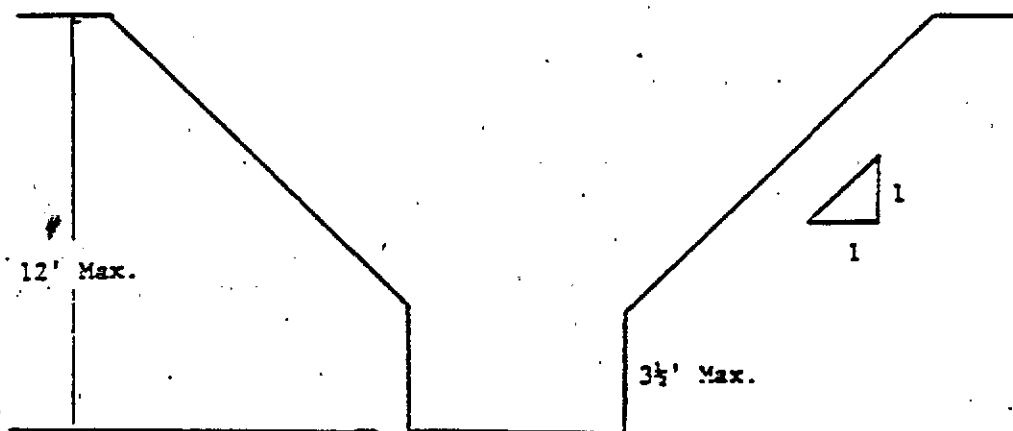
**Multiple Bench**

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3 1/4 feet.



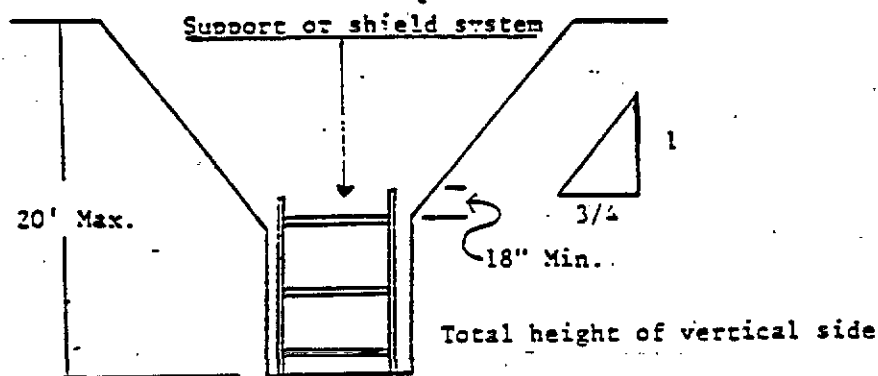
#### Unsupported Vertically Sided Lower Portion—Maximum 8 Feet in Depth

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3 1/2 feet.



#### Unsupported Vertically Sided Lower Portion—Maximum 12 Feet in Depth

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of 3/4:1. The support or shield system must extend at least 18 inches above the top of the vertical side.

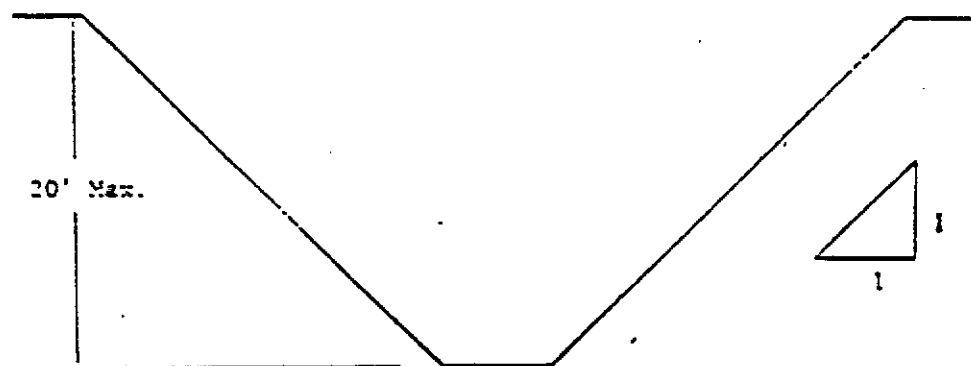


#### Supported or Shielded Vertically Sided Lower Portion

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under § 1926.652(b).

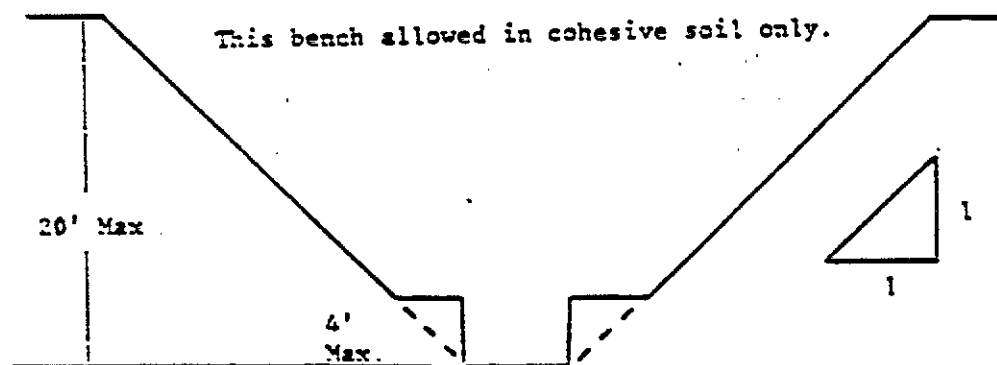
#### B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.

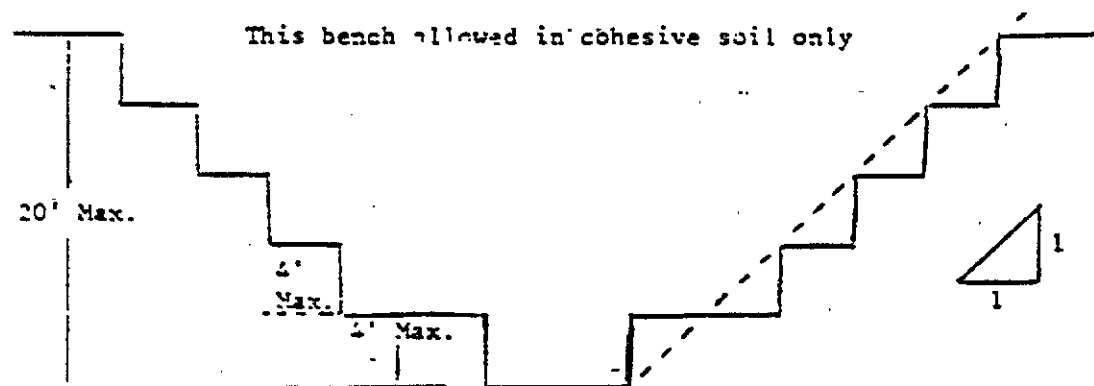


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

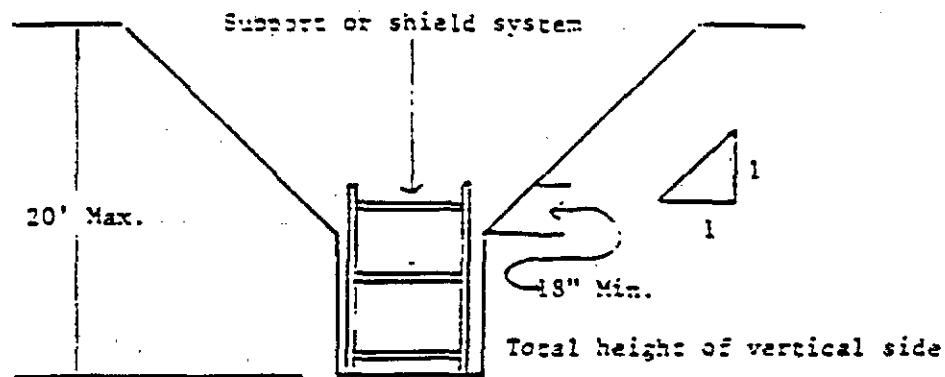


Single Bench



Multiple Bench

3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

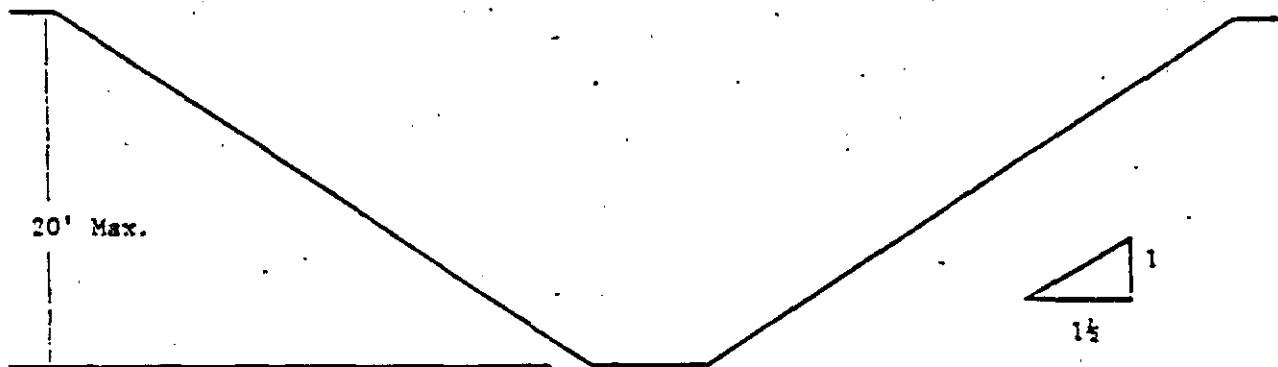


#### Vertically Sided Lower Portion

4. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

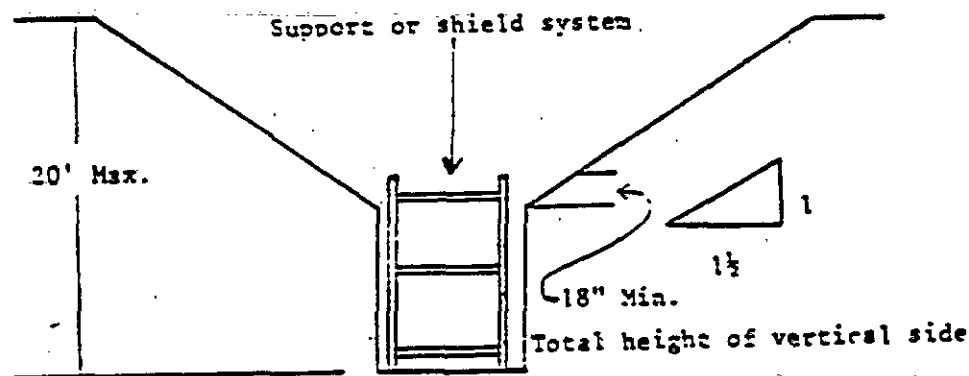
#### B-1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1.



#### Simple Slope

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1.

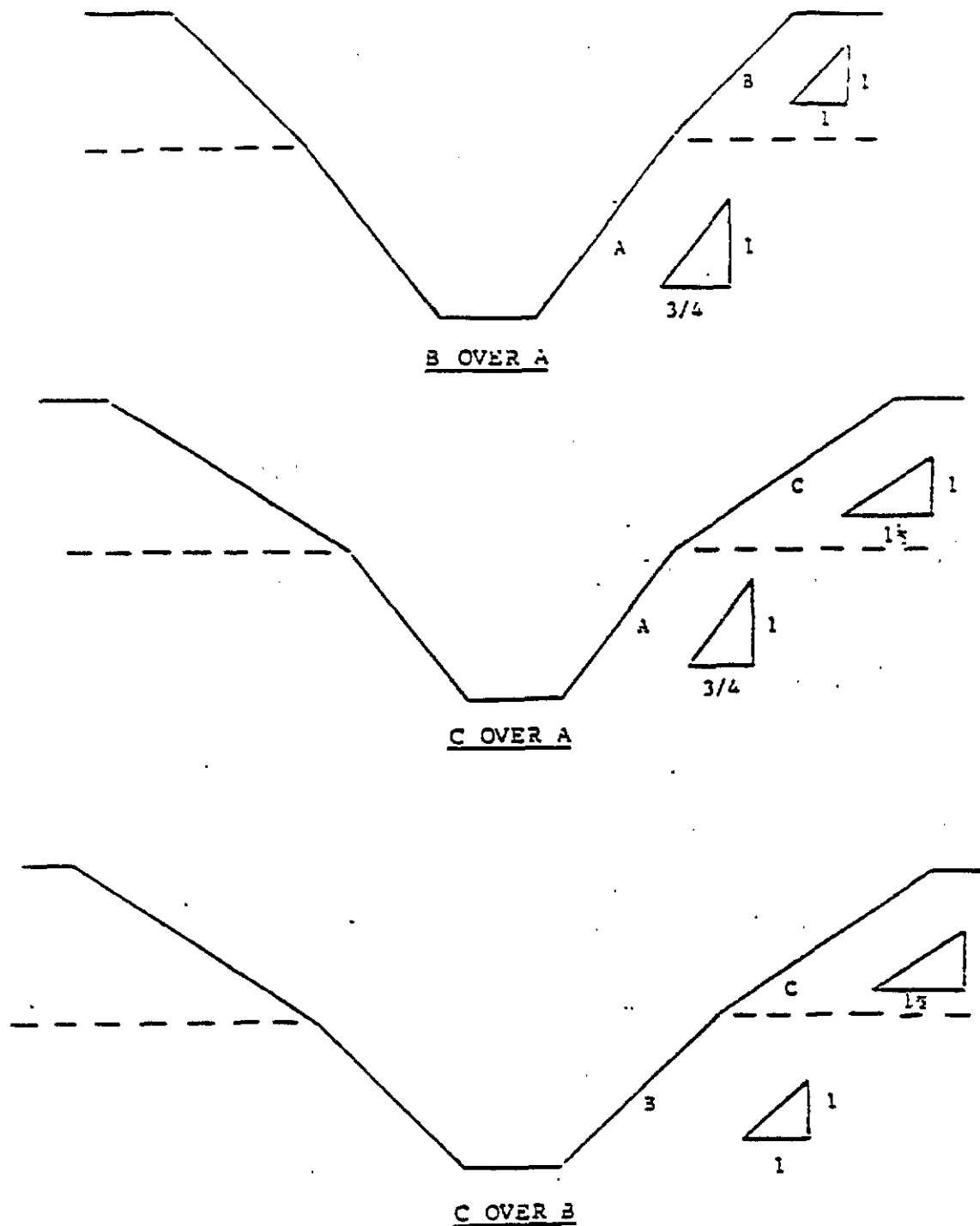


#### Vertical Sided Lower Portion

1. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

#### B-1.4 Excavations Made in Layered Soils

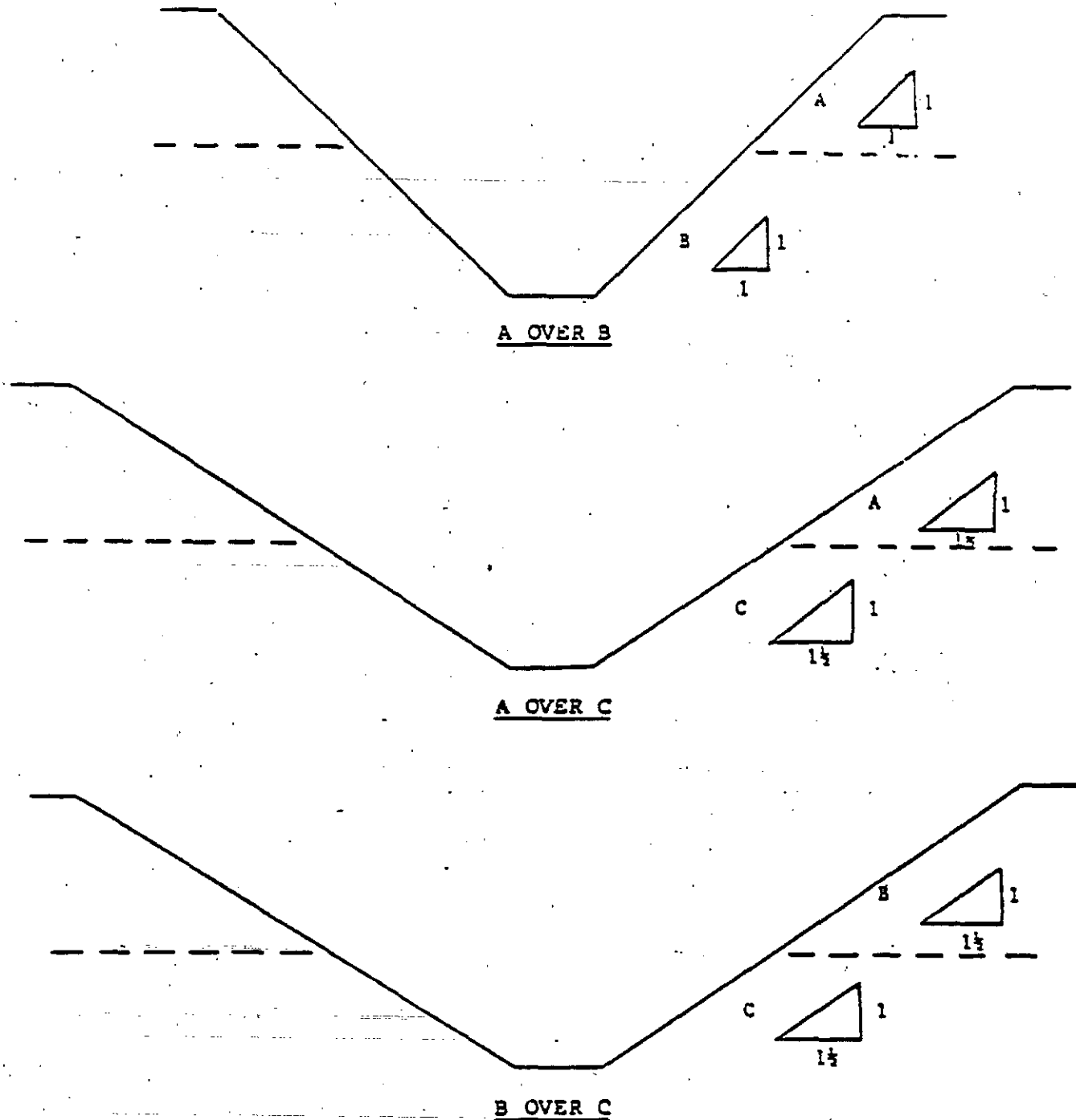
1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.



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2. All other sloped excavations shall be in accordance with the other options permitted in § 1928.652(b).

#### Appendix C to Subpart P

##### Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20

feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with § 1928.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing

systems must be designed in accordance with the requirements set forth in § 1928.652(b) and § 1928.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil

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classification method set forth in appendix A of subpart P of this part.

(c) *Preservation of Information.*

Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables C-1.1, C-1.2, and C-1.3, and Tables C-2.1, C-2.2 and C-2.3 following paragraph (c) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C-1.1 through C-1.3 and Tables C-2.1 through C-2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C-1.1 through C-1.3 are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C-1.1 through C-1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C-2.1 through C-2.3, or have this choice under § 1926.652(c)(3), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with § 1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term "adjacent"

as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 10,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unshored: The sloped portion is sloped at an angle less steep than three horizontal to one vertical or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C-1.1 through C-1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 13 feet deep and five feet wide.

From Table C-1.1, for acceptable arrangements of timber can be used.

*Arrangement #1*

Space 4×4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3×8 uprights at six feet horizontally. This arrangement is commonly called "skip shoring."

*Arrangement #2*

Space 4×6 crossbraces at eight feet horizontally and four feet vertically.

Space 8×8 wales at four feet vertically.

Space 2×6 uprights at four feet horizontally.

*Arrangement #3*

Space 6×6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8×10 wales at four feet vertically.

Space 2×6 uprights at five feet horizontally.

*Arrangement #4*

Space 6×6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10×10 wales at four feet vertically.

Spaces 3×8 uprights at six feet horizontally.

(2) *Example 2.*

A trench dug in Type B soil is 13 feet deep and five feet wide. From Table C-1.2 three acceptable arrangements of members are listed.

*Arrangement #1*

Space 6×6 crossbraces at six feet horizontally and five feet vertically.

Space 8×8 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

*Arrangement #2*

Space 6×8 crossbraces at eight feet horizontally and five feet vertically.

Space 10×10 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

*Arrangement #3*

Space 8×8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Space 2×6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 15 feet deep and five feet wide.

From Table C-1.3 two acceptable arrangements of members can be used.

*Arrangement #1*

Space 8×8 crossbraces at six feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Position 2×6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

*Arrangement #2*

Space 8×10 crossbraces at eight feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Position 2×6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using Table C-1.3. Only one arrangement of members is provided.

Space 8×10 crossbraces at six feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Use 3×6 tight sheeting.

Use of Tables C-2.1 through C-2.3 would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in § 1926.652(c), "Design of Protective Systems."

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 36 inches.

When mudsills are used, the vertical distance

shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

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TABLE C-1.1

## TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS \*

SOIL TYPE A  $P_a = 25 \text{ X H} + 72 \text{ psf}$  (2 ft Surcharge)

SIZE (ACTUAL) AND SPACING OF MEMBERS **														
DEPTH OF TRENCH (FEET)	CROSS BRACES						MALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	11
5	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---					
TO	UP TO 8	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---			2X6	2X8	
10	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4		2X6			
	UP TO 12	4X6	4X6	6X6	6X6	6X6	4	8X8	4		2X6	2X6		
10	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---			3X8		
TO	UP TO 8	4X6	4X6	6X6	6X6	6X6	4	8X8	4	2X6				
15	UP TO 10	6X6	6X6	6X6	6X6	6X8	4	8X10	4		2X6			
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	10X10	4			3X8		
15	UP TO 6	6X6	6X6	6X6	6X8	6X8	4	6X8	4	3X6				
TO	UP TO 8	6X6	6X6	6X6	6X8	6X8	4	8X8	4	3X6				
20	UP TO 10	8X8	8X8	8X8	8X8	8X10	4	8X10	4	3X6				
	UP TO 12	8X8	8X8	8X8	8X8	8X10	4	10X10	4	3X6				
OVER 20														
SEE NOTE 1														

SEE NOTE 1

\* Mixed oak or equivalent with a bending strength not less than 850 psi.

\*\* Manufactured members of equivalent strength may be substituted for wood.

TABLE C-1.2

## TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS \*

SOIL TYPE B P<sub>a</sub> = .45 X 11 + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**													
	CROSS BRACES					WALES			UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3		
5	UP TO 6	4X6	4X6	6X6	6X6	6X6	5	6X8	5					
TO 10	UP TO 8	6X6	6X6	6X6	6X8	6X8	5	8X10	5				2X6	
	UP TO 10	6X6	6X6	6X6	6X8	6X8	5	10X10	5				2X6	
	See Note 1													
10	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5			2X6		
TO 15	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5			2X6		
	UP TO 10	8X8	8X8	8X8	8X8	8X10	5	10X12	5			2X6		
	See Note 1													
15	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5			3X6		
TO 20	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5			3X6		
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5			3X6		
	See Note 1													
OVER 20	SEE NOTE 1													

\* Mixed oak or equivalent with a bending strength not less than 850 psi.

\*\* Manufactured members of equivalent strength may be substituted for wood.

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TABLE G-1.1

## TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS \*

SOIL TYPE C P<sub>a</sub> = 80 X N + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**												UPRIGHTS		
	CROSS BRACES						VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)								CLOSE					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15									
5 TO 10	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	2X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6					
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6					
10 TO 15	See Note 1														
	UP TO 6	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6					
	UP TO 8	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6					
15 TO 20	See Note 1														
	See Note 1														
	UP TO 6	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6					
20 TO OVER 20	See Note 1														
	See Note 1														
	See Note 1														
OVER 20	See Note 1														

\* Mixed Oak or equivalent with a bending strength not less than 850 psi.

\*\* Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS \*

SOIL TYPE A  $P_a = 25 \text{ X II} + 72 \text{ psf}$  (2 ft. Surcharge)

SIZE (S4S) AND SPACING OF MEMBERS **																
DEPTH OF TRENCH (FEET)	CROSS BRACES					WALES		UPRIGHTS								
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)						
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8		
5 TO 10	UP 6	4X4	4X4	4X4	4X4	4	4X6	4	Not Req'd				4X6			
	UP 8	4X4	4X4	4X4	4X6	4	4X6	4	Not Req'd						4X8	
	UP 10	4X6	4X6	4X6	6X6	4	6X6	4	8X8	4			4X6			
10 TO 15	UP 12	4X6	4X6	4X6	6X6	4	6X6	4	8X8	4				4X6		
	UP 6	4X4	4X4	4X4	6X6	4	6X6	4	Not Req'd	Not Req'd				4X10		
	UP 8	4X6	4X6	4X6	6X6	4	6X6	4	6X8	4		4X6				
15 TO 20	UP 10	6X6	6X6	6X6	6X6	4	6X6	4	8X8	4			4X8			
	UP 12	6X6	6X6	6X6	6X6	4	6X6	4	8X10	4		4X6		4X10		
	UP 6	6X6	6X6	6X6	6X6	4	6X6	4			3X6					
20 TO 25	UP 8	6X6	6X6	6X6	6X6	4	6X6	4	8X8	4		4X12				
	UP 10	6X6	6X6	6X6	6X6	4	6X6	4	8X10	4	3X6					
	UP 12	6X6	6X6	6X6	6X6	4	6X6	4	8X12	4	3X6	4X12				
OVER 20		6X6	6X6	6X6	6X6	4	6X6	4	8X12	4	3X6	4X12				
SEE NOTE 1																

SEE NOTE 1

\* Douglas fir or equivalent with a bending strength not less than 1500 psi.

\*\* Manufactured members of equivalent strength may be substituted for wood.

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TABLE C-2.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS \*

SOIL TYPE B P = 45 X H + 72 psf (2 ft. Surcharge)

SIZE (S4S) AND SPACING OF MEMBERS **															
DEPTH OF TRENCH (FEET)	CROSS BRACES						RAILES		UPRIGHTS						
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VENT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3	4	6	
5	UP TO 6	4X6	4X6	4X6	6X6	6X6	5	6X8	5						4X12
TO	UP TO 8	4X6	4X6	6X6	6X6	6X6	5	8X8	5		3X8		4X8		
10	UP TO 10	4X6	4X6	6X6	6X6	6X8	5	8X10	5			4X8			
	See Note 1														
10	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5	3X6	4X10				
TO	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5	3X6	4X10				
15	UP TO 10	6X8	6X8	8X8	8X8	8X8	5	10X12	5	3X6	4X10				
	See Note 1														
15	UP TO 6	6X8	6X8	6X8	6X8	8X8	5	8X10	5	4X6					
TO	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X12	5	4X6					
20	UP TO 10	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6					
	See Note 1														
OVER 20	SEE NOTE 1														

\* Douglas fir or equivalent with a bending strength not less than 1500 psi.

\*\* Manufactured members of equivalent strength may be substituted for wood.

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TABLE C-2.1

## TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS \*

SOIL TYPE C  $P_a = 80 \text{ X } 11 + 72 \text{ psf (2 ft. Surcharge)}$ 

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **										UPRIGHTS		
	CROSS BRACES					MALES		VERT. SPACING (FEET)			MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)		
	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)		SIZE (IN)			CLOSE		
	HORIZ. SPACING (FEET)	UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15	VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	CLOSE			
5	UP TO 6	6X6	6X6	6X6	6X6	8X8	5	8X8	5	3X6			
TO 10	UP TO 8	6X6	6X6	6X6	8X8	8X8	5	10X10	5	3X6			
10	UP TO 10	6X6	6X6	8X8	8X8	8X8	5	10X12	5	3X6			
	See Note 1												
10	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	10X10	5	4X6			
TO 15	UP TO 8	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6			
	See Note 1												
	See Note 1												
15	UP TO 6	8X8	8X8	8X8	8X10	8X10	5	10X12	5	4X6			
TO 20	See Note 1												
	See Note 1												
	See Note 1												
OVER 20	See Note 1												

\* Douglas fir or equivalent with a bending strength not less than 1500 psi.

\*\* Manufactured members of equivalent strength may be substituted for wood.

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## Appendix D to Subpart P

## Aluminum Hydraulic Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with § 1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D-1.1, D-1.2, D-1.3 and D-1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D-1.1 and D-1.2 are for vertical shores in Types A and B soil. Tables D-1.3 and D-1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D-1.1 through D-1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled "Aluminum Hydraulic Shoring: Typical Installations."

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D-1 Tables. Aluminum material is 6061-T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum 2-inch inside diameter with a minimum safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly

experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with § 1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion or a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D-1.1, D-1.2, D-1.3 and D-1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D-1.1 and D-1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D-1.3 and D-1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to illustrate the Use of the Tables:*

(1) Example 1:

A trench dug in Type A soil is 8 feet deep and 3 feet wide. From Table D-1.1: Find vertical shores and 2 inch diameter cylinders spaced 8 feet on center (o.c.) horizontally and 4 feet on center (o.c.) vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting, 13 feet deep and 5 feet wide. From Table D-1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is 16 feet deep and 9 feet wide. From

Table D-1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeve: as designated by footnote #2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically. Plywood (per footnote #7) to the trench should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics a Type C soil, and will require sheeting. The trench is 18 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D-1: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3x12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D-1.4: Find horizontal wale with a section modulus of 2 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet vertically. 3x12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D-1.1, D-1.2, D-1.3, and D-1.4.*

(1) For applications other than those listed in the tables, refer to § 1926.652(c)(2) for use of manufacturer's tabulated data. For depths in excess of 20 feet, refer to § 1926.652(c)(2) and § 1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width shall have structural steel tube (3.5x3.5x0.1875) oversleeves, or structural oversleeves of manufacturer's specification extending the full, collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.25 inch thick softwood or 0.75 inch thick, 14 ply, arctic white birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of raveling (sloughing) of the trench between shores.

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(8) See appendix C for timber specifications.

(9) Wales are calculated for simple span conditions.

(10) See appendix D, item (d), for basis and limitations of the data.

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Attachment G-1

# ALUMINUM HYDRAULIC SHORING TYPICAL INSTALLATIONS

FIGURE NO. 1  
VERTICAL ALUMINUM  
HYDRAULIC SHORING  
(SPOT BRACING)

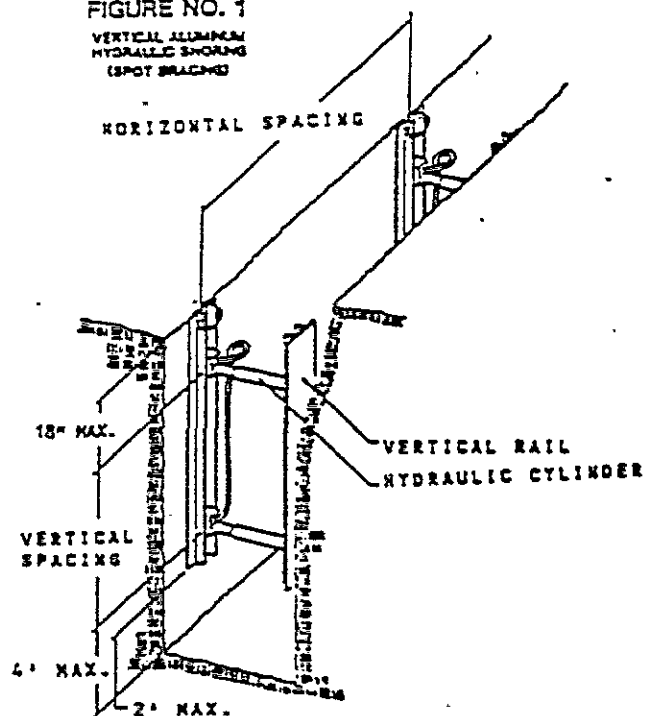


FIGURE NO. 2  
VERTICAL ALUMINUM  
HYDRAULIC SHORING  
(WITH PLYWOOD)

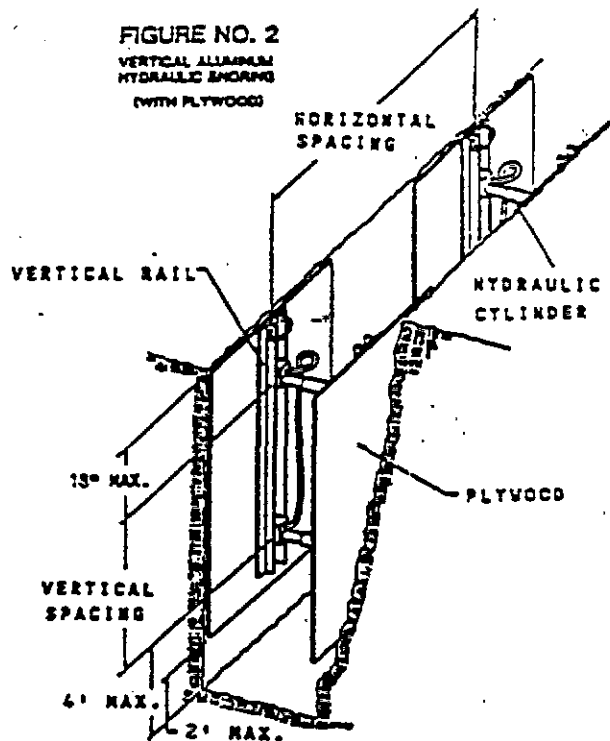


FIGURE NO. 3  
VERTICAL ALUMINUM  
HYDRAULIC SHORING  
(STACKED)

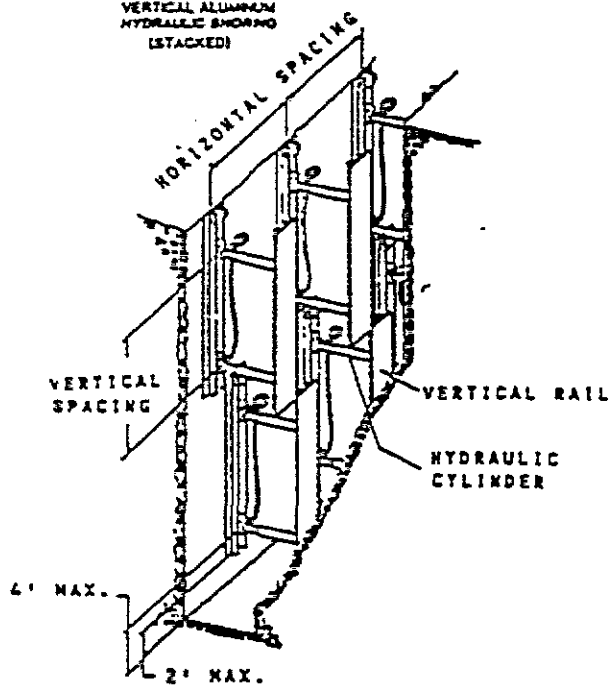


FIGURE NO. 4  
ALUMINUM HYDRAULIC SHORING  
WALER SYSTEM  
(TYPICAL)

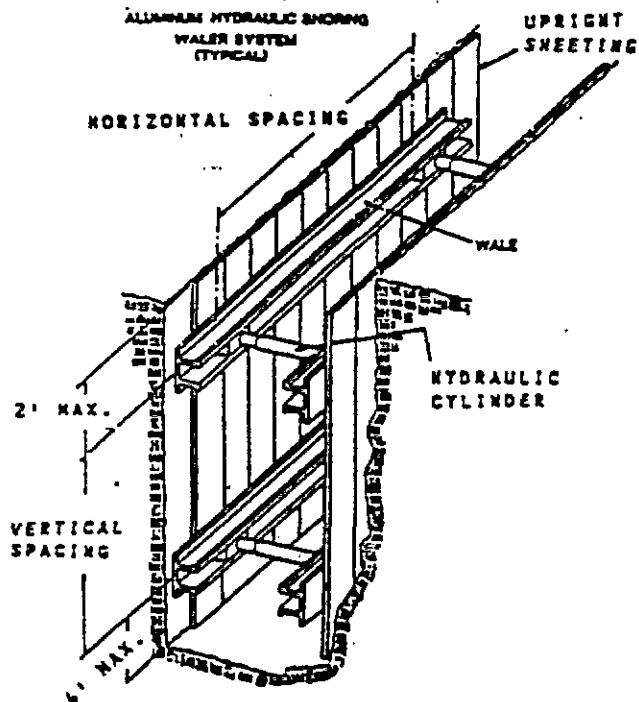


TABLE D - 1.1  
ALUMINUM HYDRAULIC SHORING  
VERTICAL SHORES  
FOR SOIL TYPE A

HYDRAULIC CYLINDERS				
DEPTH OF TRENCH (FEET)	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)	
			UP TO 8	OVER 8 UP TO 12 TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)
OVER 10 UP TO 15	8			
OVER 15 UP TO 20	7			
OVER 20	NOTE (1)			

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Note (1): See Appendix D, Item (g) (1)

Note (2): See Appendix D, Item (g) (2)

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TABLE D - 1.2  
ALUMINUM HYDRAULIC SHORING  
VERTICAL SHORES  
FOR SOIL TYPE B

HYDRAULIC CYLINDERS					
DEPTH OF TRENCH (FEET)	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5				
OVER 15 UP TO 20	5.5				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Note (1): See Appendix D, Item (g) (1)

Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.3  
ALUMINUM HYDRAULIC SHORING  
WALER SYSTEMS  
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS								TIMBER UPRIGITS		
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN <sup>3</sup> )	WIDTH OF TRENCH (FEET)								MAX. HORIZ. SPACING (ON CENTER)		
			UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID	2 FT.	3 FT.		
OVER 5 UP TO 10	4	3.5	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	3 IN	—	—	3x12	
		7.0	9.0	2 IN	9.0	NOTE(2)	2 IN	8.0					3 IN
		14.0	12.0	3 IN	12.0	3 IN	12.0	3 IN					
OVER 10 UP TO 15	4	3.5	6.0	2 IN	6.0	NOTE(2)	2 IN	6.0	3 IN	—	3x12	—	
		7.0	8.0	3 IN	8.0	3 IN	8.0	3 IN					
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN					
OVER 15 UP TO 20	4	3.5	5.5	2 IN	5.5	NOTE(2)	2 IN	5.5	3 IN	3x12	—	—	
		7.0	6.0	3 IN	6.0	3 IN	6.0	3 IN					
		14.0	9.0	3 IN	9.0	3 IN	9.0	3 IN					
OVER 20	NOTE (1)												

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Notes (1): See Appendix D, item (g) (1)

Notes (2): See Appendix D, item (g) (2)

\* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

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TABLE D-1.4  
ALUMINUM HYDRAULIC SHORING  
WALER SYSTEMS  
FOR SOIL TYPE C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS								TIMBER UPRIGHTS		
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN <sup>4</sup> )	WIDTH OF TRENCH (FEET)								MAX. HORIZ. SPACING (ON CENTER)		
			UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID	2 FT.	3 FT.		
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER				SHEET	
OVER 5 UP TO 10	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	3x12	—	—		
		7.0	6.5	2 IN	6.5	NOTE(2)	6.5	3 IN					
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN					
OVER 10 UP TO 15	4	3.5	4.0	2 IN	4.0	2 IN NOTE(2)	4.0	3 IN	3x12	—	—		
		7.0	5.5	3 IN	5.5	3 IN	5.5	3 IN					
		14.0	8.0	3 IN	8.0	3 IN	8.0	3 IN					
OVER 15 UP TO 20	4	3.5	3.5	2 IN	3.5	2 IN NOTE(2)	3.5	3 IN	3x12	—	—		
		7.0	5.0	3 IN	5.0	3 IN	5.0	3 IN					
		14.0	6.0	3 IN	6.0	3 IN	6.0	3 IN					
OVER 20	NOTE (1)												

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Notes (1): See Appendix D, item (g) (1)

Notes (2): See Appendix D, item (g) (2)

\* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

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Attachment G-1



Appendix E to Subpart P—Alternatives to Timber Shoring

Figure 1. Aluminum Hydraulic Shoring

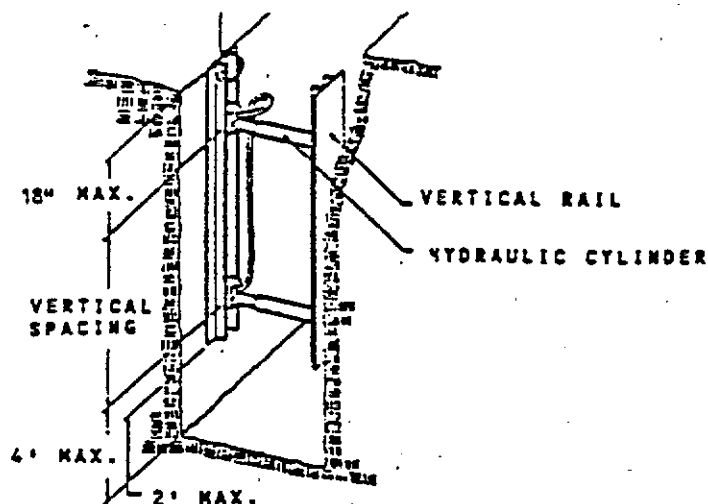


Figure 2. Pneumatic/hydraulic Shoring

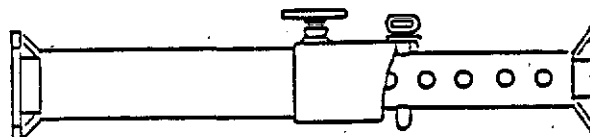
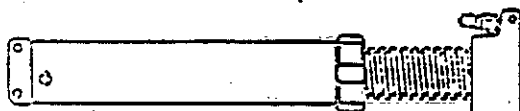


ILLUSTRATION CODE 4510-267

## Appendix F to Subpart P—Selection of Protective Systems

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with § 1926.652 (b) and (c).

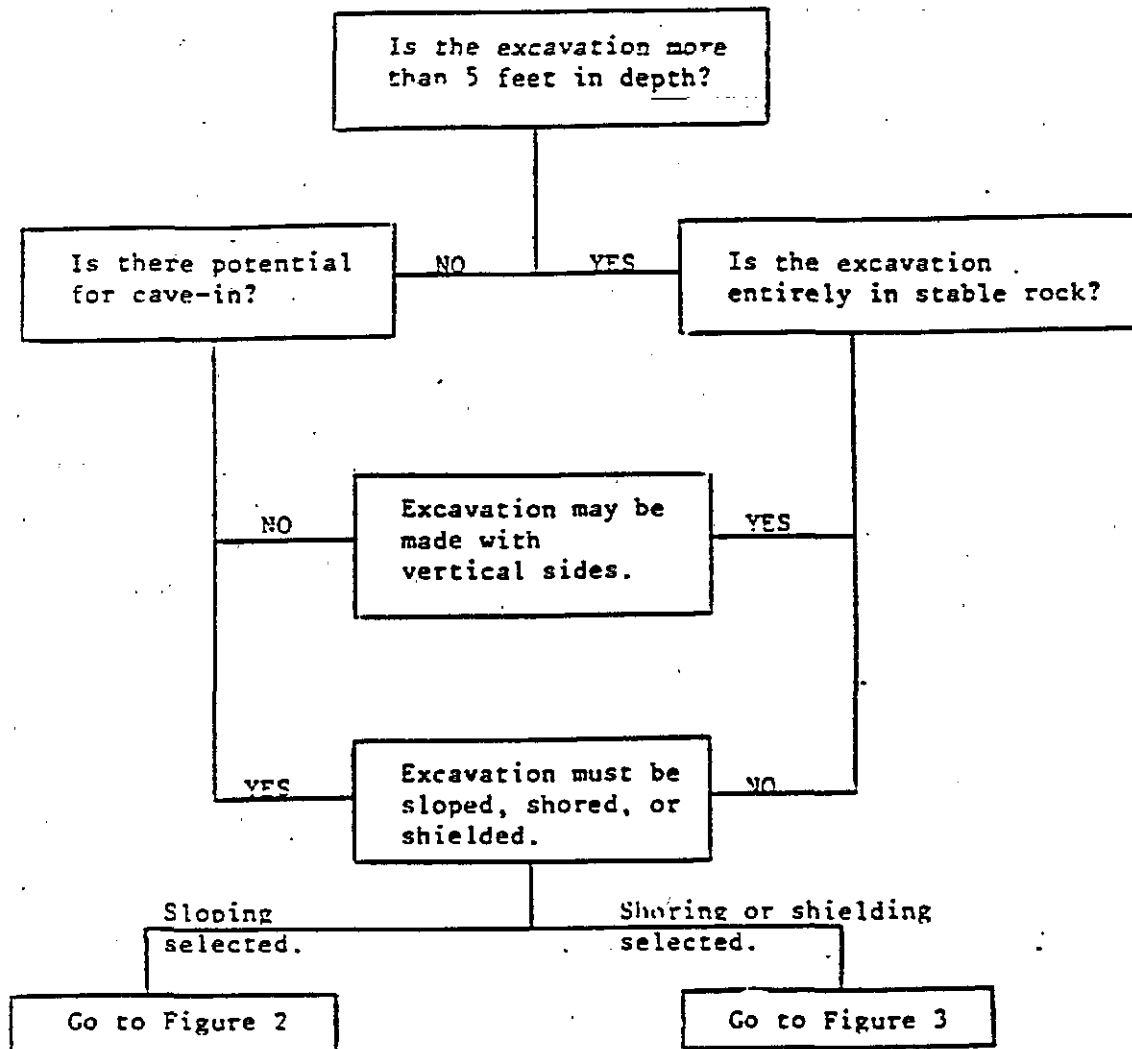


FIGURE 1 - PRELIMINARY DECISIONS

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Figure 3. Trench Jacks (Screw Jacks)

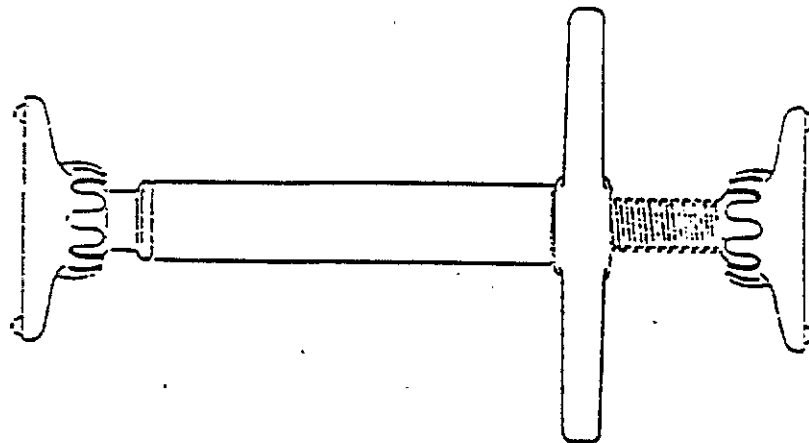
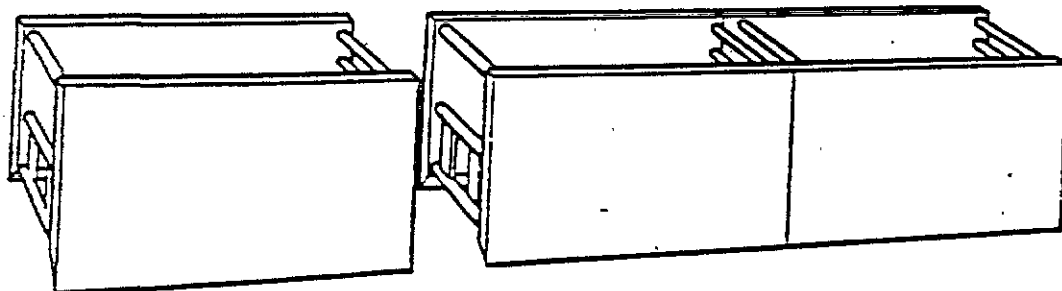
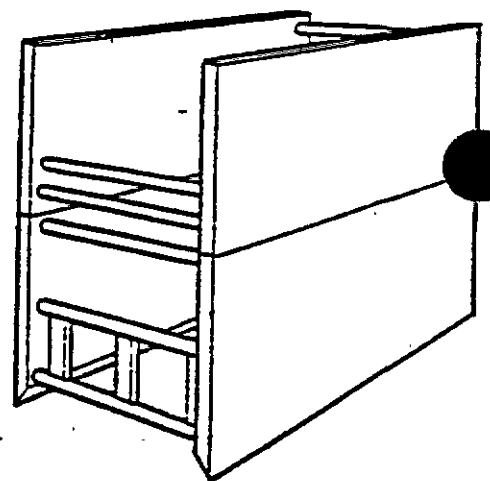
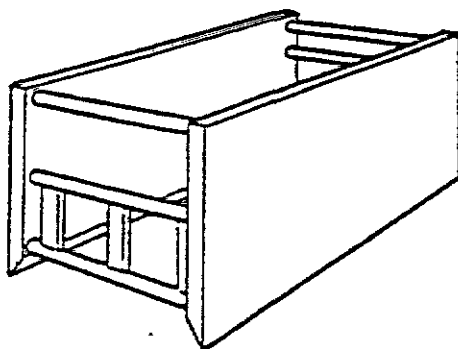


Figure 4. Trench Shields



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Attachment G-1

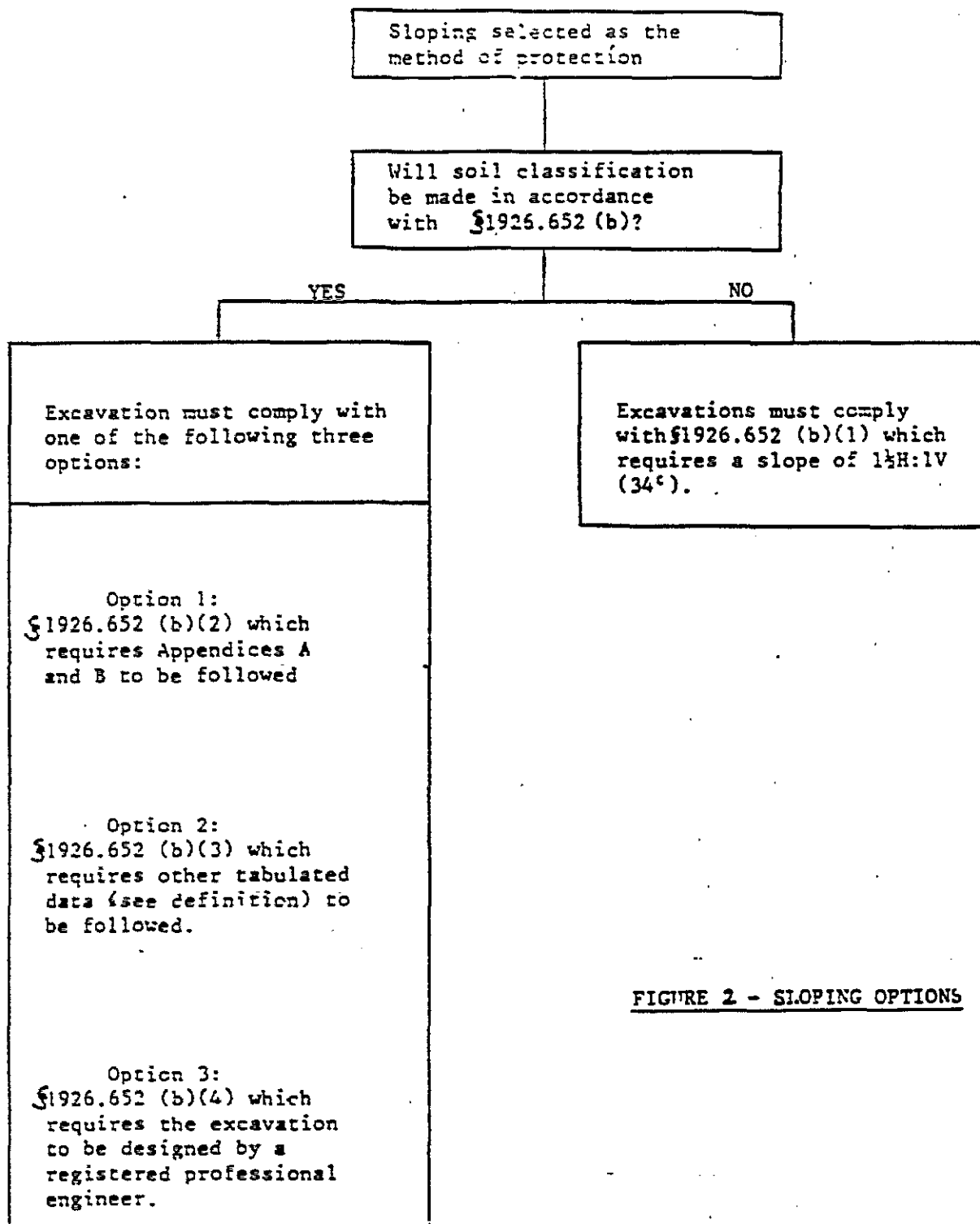


FIGURE 2 - SLOPING OPTIONS

Shoring or shielding selected  
as the method of protection.

Soil classification is required  
when shoring or shielding is  
used. The excavation must comply  
with one of the following four  
options:

Option 1

§1926.652 (c)(1) which requires  
Appendices A and C to be followed  
(e.g. timber shoring).

Option 2

§1926.652 (c)(2) which requires  
manufacturers data to be followed  
(e.g. hydraulic shoring, trench  
jacks, air shores, shields).

Option 3

§1926.652 (c)(3) which requires  
tabulated data (see definition)  
to be followed (e.g. any system  
as per the tabulated data).

Option 4

§1926.652 (c)(4) which requires  
the excavation to be designed  
by a registered professional  
engineer (e.g. any designed  
system).

FIGURE 3 - SHORING AND SHIELDING OPTIONS

[FR Doc. 89-25217 Filed 10-30-89; 8:45 am]

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Attachment G-1



*Confined Space*  
**H/** Entry Procedures

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## Appendix H: Confined Space Entry Procedures

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3.0	Atmospheric Conditions	H-2
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6.0	Additional Requirements of All Confined Space Entry	H-6
7.0	Entry Permit System	H-6

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Table H-2	Confined Space Entry Requirements for Barr Employees	H-5

### Attachments

Attachment H-1	Confined Space Entry Permit
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## Appendix H: Confined Space Entry Procedures

### 1.0 Policy

Confined spaces are any excavation, trench, manhole(s), vessel, or other enclosed space where there may be a potential for dangerous air concentrations (defined in 2.2.1.1 below), limited egress, or engulfment. Barr has established confined space entry procedures that comply with Minnesota OSHA Regulation 5205 - Confined Spaces. These regulations require Barr to establish training programs and procedures for issuing permits for employees who must work in confined spaces.

All Barr employees are required to follow the Barr Confined Space Entry Program. Entry to confined spaces generally requires permitting, air monitoring, and ventilating. The Barr Confined Space Entry Permit Form must be completed prior to any confined space entry and followed during the confined space entry.

### 2.0 Definition of Confined Space

**2.1 Minnesota Occupational Safety and Health Standard 5205-Confined Spaces** mandates minimum requirements for confined space entry. The following definitions have been excerpted from this standard.

**2.1.1 Confined Space Entry** is any action resulting in any part of a person's face breaking the plane of any opening of the confined space, and includes any work activities inside the confined space.

**2.2 Confined spaces** are defined as a special configuration that could result in any of the following:

**2.2.1 Atmospheric Condition** - a condition in which a dangerous air contamination, oxygen deficiency, or oxygen enrichment may exist or develop; where

**2.2.1.1 Dangerous Air** contamination is defined as:

- a) an atmosphere containing gas or vapor at a concentration greater than 10 percent of its lower explosive limit (LEL),
- b) An atmosphere containing particulates at a concentration greater than 10 percent of the minimum explosive concentration.
- c) An atmosphere containing a toxic, corrosive, or asphyxiant substance in excess of the OSHA permissible exposure limit (PEL), or short-term exposure limit (STEL).
- d) An atmosphere containing a toxic, corrosive, or asphyxiant substance in excess of Immediately Dangerous to Life or Health (IDLH) level.

**2.2.1.2 Oxygen Deficiency** is defined as an atmosphere containing less than 19.5 percent oxygen by volume.

**2.2.1.3 Oxygen Enrichment** is defined as an atmosphere containing greater than 23 percent oxygen by volume.

**2.2.2 Entry/Exit Access** - a condition where the emergency removal of a suddenly disabled person is difficult due to the location or size of the access opening.

2.2.3 Engulfment Condition - a condition where the risk of engulfment exists or could develop.

### 3.0 Atmospheric Conditions

Examples of conditions potentially leading to Dangerous Air contamination or Oxygen Deficiency/Enrichment:

- Organic decay depleting oxygen and generating methane (combustible and asphyxiant); and hydrogen sulfide (combustible and toxic);
- Rust formation consuming oxygen; or
- Other known, suspected, or unidentified chemical reactions specific to the confined space.

### 4.0 Confined Space Classification

There are three classes of confined space - Class I, Class II, and Class III. Each of these types are described below and summarized in TABLE H-1: EXAMPLES OF CONFINED SPACE CLASSIFICATIONS. These confined spaces have been classified according to the classification scheme described in the Minnesota Confined Spaces Standard. These examples are for illustration purposes only and are not intended to be inclusive of all circumstances where a confined space entry permit may be required.

4.1 **Class I Confined Space:** An atmosphere with a dangerous air contamination, oxygen deficiency or oxygen enrichment is **unlikely** to develop and where no risk engulfment exists, and where atmosphere cannot develop a dangerous air contaminant or oxygen enrichment. An annual or daily permit is required prior to entry.

a) Examples of Class I Confined Space:

- Gauging Station
- Storm Sewer Dry Well
- Storm Sewer (under construction)
- Sanitary Sewer (under construction)
- Storm Sewer
- Metering Station Sanitary Sewer
- Storm Sewer Wet Well
- Sanitary Sewer Dry Well
- Storm Sewer (operable)
- New Vessels

4.2 **Class II Confined Space:** An atmosphere free of dangerous air contamination, oxygen deficiency, or oxygen enrichment has been verified. A daily confined space entry permit is required prior to entry.

a) Examples of Class II Confined Space:

- Sanitary Sewer
- Metering Station Sanitary Sewer
- Storm Sewer Wet Well
- Storm Sewer (operable)
- Sanitary Sewer Wet Well

- Sanitary Sewer Dry Well
- Sanitary Sewer (operable)
- Trenches <4 feet deep in soil containing or suspected to contain hazardous substances
- Trenches >4 feet deep in soil containing or suspected to contain hazardous substances
- Used Vessels - Cleaned/Purged

**4.3 Class III Confined Space:** An atmosphere free of dangerous air contamination **cannot be verified**. A daily confined space permit is required prior to entry.

a) Examples of Class III Confined Space:

- Sanitary Sewer
- Sanitary Sewer Wet Well
- Sanitary Sewer (operable)
- Trenches <4 feet deep in soil containing or suspected to contain hazardous substances
- Trenches >4 feet deep in soil containing or suspected to contain hazardous substances
- Vessels - Unknown Contents

**Table H-1**  
**Examples of Confined Space Classifications**

	Possible Classification		
	I	II	III
<b>Manholes</b>			
Gauging Station	X		
Storm Sewer	X		
Sanitary Sewer		X	X
Metering Station Sanitary Sewer	X	X	
<b>Lift Station</b>			
Storm Sewer Dry Well	X		
Storm Sewer Wet Well	X	X	
Sanitary Sewer Dry Well	X	X	
Sanitary Sewer Wet Well		X	X
<b>Drainage/Waste Pipes</b>			
Storm Sewer (under construction)	X		
Storm Sewer (operable)	X	X	
Sanitary Sewer (under construction)	X		
Sanitary Sewer (operable)		X	X
<b>Excavations/Trenches in Soil Containing or Suspected to Contain Hazardous Substances</b>			
Trenches <4 feet deep		X	X
Trenches >4 feet deep		X	X
<b>Vessels</b>			
New Vessels	X		
Used Vessel-Cleaned/Purged		X	
Vessel-unknown contents			X

## 5.0 Requirements for Confined Space Entry

Entry to a confined space requires permitting, air monitoring, and ventilating. In general, Barr's specific requirements for each class of confined space follows.

- 5.1 Class I:** Requires mechanical ventilation or natural ventilation of at least six (6) air changes per hour, or preentry, continuous oxygen, combustibles, and/or toxics monitoring; and stand-by person with visual/verbal communication ready to give assistance in event of emergency.

- 5.2 **Class II:** Requires preentry and continuous oxygen, combustibles and/or toxics monitoring; mechanical ventilation if required by monitoring results; and stand-by person with visual/verbal communication ready to give assistance in event of emergency.
- 5.3 **Class III:** Requires preentry and continuous oxygen, combustibles and/or toxics monitoring, mechanical ventilation if required by monitoring results, stand-by person with visual/verbal communication ready to give assistance in event of emergency and trained in first aid and cardiopulmonary resuscitation (CPR), respiratory protection, and safety belt/harness with attached line.

TABLE H-2 summarizes these requirements.

**Table H-2**  
**Confined Space Entry Requirements for Barr Employees**

Requirements		Class I	Class II	Class III
Ventilation	Mechanical Ventilation - Prior to Entry	O*	O	O
	Ventilation - Continuous 200 CFM or 6 Air Change/Hour	O*	R <sup>1</sup>	R <sup>1</sup>
Monitoring	Monitoring - O <sub>2</sub> , LEL, Toxics Prior to entry	R	R	R
	Monitor - O <sub>2</sub> Prior to Entry and Continuous	-	-	-
	Monitoring - O <sub>2</sub> , LEL, Toxics Continuous	R	R	R
Stand-By Person	Stand-By Person	R (Barr)	R	R
Communication	Communication Visual/Verbal	R (Barr)	R	R
Life Line	Safety Line Attached	-	R <sup>2</sup>	R
	Hoisting Device - Top Opening	-	-	R
Respirators	Respiratory Protection	-	-	R
Permit	Annual Permit Allowed	Y	N	N

R: Required

O: Optional

-: Does not apply

\* Choose one or more action

<sup>1</sup>: If dangerous air contamination

<sup>2</sup>: If practical

(Barr): Barr policy only. Not required in Minnesota Rule

## 6.0 Additional Requirements of All Confined Space Entry

Additional requirements for all confined space entries are:

- Recording all air monitoring results on permit.
- Using personal protective equipment appropriate to hazards of confined space.
- Observing all health and safety requirements for other operations in the confined space, such as proper use of electrical equipment when working in a wet environment.
- Observing safety requirements for client's confined space entry program.
- Filing confined space entry permit (yellow copy) in project file.
- Sending original copy (white copy) to Barr Health and Safety Manager prior to entry. Sending signed last copy (manila color) upon completion of confined space entry to Barr Health and Safety Manager.

## 7.0 Entry Permit System

Barr will issue an "annual" or "daily" type of permit, depending on the situation. Barr staff shall not enter confined space without an appropriate written Confined Space Entry Permit. Permits will be issued by the Barr Health and Safety Manager, another Barr Industrial Hygienist, or by the Project Manager (in order of preference). Permits will be completed and present during confined space entry. Permits will be issued on the Barr Confined Space Entry Form (Attachment H-1).

**7.1 Daily Permit:** A daily permit must be issued for entry into any class of confined space when an annual permit does not exist. Daily permits will be issued in triplicate: office copy, project copy, and field copy. The office copy will be kept by the person issuing the confined space permit and routed to the Barr Health and Safety Manager. The project and field copies will be kept in the field during confined space entry. Upon completion of the entry, the project copy will be filed and the field copy will be signed and returned to the Barr Health and Safety Manager. Any air monitoring results above action levels should be documented and communicated to the Project Manager and the Barr Health and Safety Manager.

**7.2 Annual Permit:** The OSHA Confined Space Entry standard allows an "annual permit" to be issued for entry into Class I Confined Spaces where routine entry is required. These annual permits will be issued by the Barr Health and Safety Manager only. Annual permits will also use the triplicate form, with the Barr Health and Safety Manager retaining the office copy and the Project Manager retaining the project copy. The field copy will be present at the job site during each confined space entry.

### 7.3 Contents of Confined Space Entry Permit

The Confined Space Entry permit will identify the:

- Location of Confined Space
- Class of Confined Space
- Date of Issuance and Expiration Date
- Air Monitoring Equipment and Contaminants which may be encountered;
- Air Monitoring Frequency
- Ventilation Needs

- Stand-by Person Requirements
- Safety Belt/Harness and Lifeline Requirements
- Reserve Retrieval Equipment
- Respiratory Protection
- Illumination Needs

*ATTACHMENT H-1*

AR307601



# Attachment H-1 CONFINED SPACE ENTRY PERMIT

BARR ENGINEERING: CONFINED SPACE ENTRY PERMIT	GENERAL INFORMATION		
	Project Name: _____		Project Number: _____
	Space to be Entered: _____		Purpose of Entry: _____
	_____		_____
	_____		_____
	Location: _____		Authorized Duration of Permit Date: _____ to _____ Time: _____ to _____
	<b>CLASS OF ENTRY:</b> <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C		
	<b>PERMIT SPACE HAZARDS:</b> (Check all that may apply)		
	<input type="checkbox"/> Oxygen deficiency (less than 19.5%) <input type="checkbox"/> Oxygen enrichment (greater than 23%) <input type="checkbox"/> Flammable gases or vapors (greater than 10% LEL) <input type="checkbox"/> Toxic gases or vapors (greater than PEL/TLV) <input type="checkbox"/> Mechanical hazards <input type="checkbox"/> Overhead hazards <input type="checkbox"/> Electrical shock <input type="checkbox"/> Materials harmful to skin <input type="checkbox"/> Engulfment <input type="checkbox"/> Flowing/standing water <input type="checkbox"/> Slippery walking conditions <input type="checkbox"/> Low light conditions <input type="checkbox"/> Excavation entry <input type="checkbox"/> Other: _____		
	<b>PERSONAL PROTECTIVE EQUIPMENT</b> <small>(Check all that apply)</small>		
<input type="checkbox"/> Hard Hat <input type="checkbox"/> Steel Toe Leather Boots <input type="checkbox"/> Safety Glasses <input type="checkbox"/> Steel Toe Rubber Boots <input type="checkbox"/> Side Shields <input type="checkbox"/> Boot Covers <input type="checkbox"/> Ear Plugs <input type="checkbox"/> Other: _____ <input type="checkbox"/> Ear Muffs <input type="checkbox"/> Cotton Coveralls <input type="checkbox"/> Kleengard <input type="checkbox"/> Tyvek <input type="checkbox"/> Poly-Coated Tyvek <input type="checkbox"/> Saranex Tyvek <input type="checkbox"/> Gloves <input type="checkbox"/> APR Respirator Type: _____ <input type="checkbox"/> ELSA Respirator Type: _____ <input type="checkbox"/> SCBA Respirator Type: _____			
<b>EMERGENCY SERVICE</b>			
Name of Service Phone Number Method of Contact Fire _____ Police _____ Ambulance _____			
<b>ATMOSPHERIC MONITORING EQUIPMENT</b> Monitor prior to entry and during entry. Leave area if alarm sounds. <input type="checkbox"/> MSA 260/360 or Microgard <input type="checkbox"/> HNU/OVA/OVM <input type="checkbox"/> CO Meter <input type="checkbox"/> H <sub>2</sub> S Meter <input type="checkbox"/> Detector Tube(s) <input type="checkbox"/> SO <sub>2</sub> Meter <input type="checkbox"/> Other: _____			
<b>OTHER EQUIPMENT</b> <input type="checkbox"/> Harness, Lifeline <input type="checkbox"/> Hoist <input type="checkbox"/> Mechanical Ventilation: _____ <input type="checkbox"/> Natural Ventilation: _____ <input type="checkbox"/> Illumination: _____ <input type="checkbox"/> Additional Permits (Hot work): _____ <input type="checkbox"/> Isolation Methods (Lockout/Tagout, Purge, Clean): _____ <input type="checkbox"/> 1st Aid/CPR Trained _____ Other: _____			
<b>COMMUNICATION PROCEDURES</b> (Visual/Verbal) _____ _____			
<b>AUTHORIZED ENTRANTS</b> Name: _____ Name: _____			
<b>AUTHORIZED ATTENDENTS</b> (Standby Person) Name: _____ Name: _____			
<b>TESTING RECORD</b>			
	Initial Reading	Continuous Reading	
Time	_____	_____	
Tester Initials	_____	_____	
Oxygen-min. >19.5%	_____	_____	
Oxygen-max. <23.0%	_____	_____	
Flammability <10% LEL	_____	_____	
H <sub>2</sub> S <5 ppm	_____	_____	
CO <25 ppm	_____	_____	
SO <sub>2</sub> <1 ppm	_____	_____	
Other	_____	_____	
<b>AUTHORIZATION BY ENTRY SUPERVISORS</b>			
PRINTED NAME	SIGNATURE	DATE TIME	
_____	_____	_____	

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AR307602

## Attachment H-1 Cont'd

### CLASS OF ENTRY

- I. Atmosphere With Dangerous Air Contamination, Oxygen Deficiency or Oxygen Enrichment Is Unlikely To Develop.
- II. Atmosphere Free of Dangerous Air Contamination, Oxygen Deficiency or Oxygen Enrichment Has Been Verified.
- III. Atmosphere Free of Dangerous Air Contamination, Oxygen Deficiency or Oxygen Enrichment Cannot Be Verified.

Requirements		Class I	Class II	Class III
Ventilation	Mechanical Ventilation - Prior To Entry	0*	0	0
	Ventilation - Continuous 200 CFM or 6 Air Change/Hour	0*	R <sup>1</sup>	R <sup>1</sup>
Monitoring	Monitoring - O <sub>2</sub> , LEL, Toxics Prior to Entry	R	R	R
	Monitor - O <sub>2</sub> , Prior to Entry and Continuous	-	-	-
	Monitoring -O <sub>2</sub> , LEL, Toxics Continuous	R	R	R
Stand-By Person	Stand-By Person	R (Barr)	R	R
Communication	Communication, Visual/Verbal	R (Barr)	R	R
Life Line	Safety Line Attached	-	R <sup>2</sup>	R
	Hoisting Device-Top Opening	-	-	R
Respirators	Respiratory Protection	-	-	R
Permit	Annual Permit Allowed	Yes	No	No

R: Required

O: Optional

- Does Not Apply

0\*: Choose one or more action

<sup>1</sup>: If dangerous air contamination

<sup>2</sup>: If practical

(Barr): Barr policy only. Not required in Minnesota Rule

AR307603

*I/* Hearing Conservation  
Program

AR307604

Appendix I: Hearing Conservation Program

Table of Contents

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4.0	Hearing Protective Devices	I-1
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6.0	Noise Monitoring	I-2
7.0	Posting of Occupational Noise Exposure Standard	I-2

## Appendix I: Hearing Conservation Program

### 1.0 Policy

Barr personnel will be provided with the equipment, training, environmental and medical surveillance, and technical support to be protected from the adverse effects of occupational exposure to noise. Barr has established a program which complies with the OSHA standard for Occupational Noise Standard (29 CFR 1910.95).

### 2.0 Action Level

Barr will implement the requirements of this policy whenever employees are, or may reasonably be expected to be exposed to noise levels in excess of 85 dBA, as an 8-hour time weighted average (TWA). Work taking place on active construction sites, around heavy equipment, or near drill rigs is assumed to have the potential for employee overexposure to noise.

### 3.0 Noise Exposure Control

Barr will, whenever practical, provide its employees with equipment that will not generate noise levels in excess of 85 dBA. In many cases, however, Barr does not have control over noisy equipment or environments (e.g., client site, other contractor activities). In such cases, the following controls should be used:

- Whenever possible, work as far from the noise source as possible.
- Where possible, position noisy equipment behind a barrier or wall.
- Minimize the length of time of exposure to loud noise through work practices and planning.
- Use hearing protective devices.

### 4.0 Hearing Protective Devices

The use of hearing protective devices (HPD) are required whenever Barr staff are exposed to noise levels in excess of 85 dBA (8-hour TWA) which cannot be otherwise controlled.

The following HPDs or comparable brands are kept in the Barr equipment room and are available for use by employees:

- EAR Plugs™, disposable foam plugs, NRR 29
- EAR Plugs™ with cord, disposable foam plugs, NRR 29
- American Optical 2000H, helmet mounted ear muffs, NRR 21

Please note that the American Optical 2000H HPDs are available on a limited basis and may not be suitable for high noise environments.

Project staff should consult the Project Health and Safety Contact or other representative of the health and safety staff concerning suitability of particular types of hearing protection. It is the responsibility of project team members to obtain from the equipment sufficient number of HPDs for the number of Barr personnel on-site and the duration of the project.

Barr staff working on projects requiring hearing protection will receive training in the use of these devices at the project pre-entry safety meeting or from the equipment technician.

### 5.0 Medical Surveillance

Barr staff who may be exposed to noise in excess of 85 dBA (8-hour TWA) will be identified by the health and safety staff. Those employees identified as potentially noise exposed will receive baseline and annual audiometric testing. Testing will be performed by a qualified audiometric technician operating under the supervision of an occupational health physician. Barr staff are informed in writing of the results of their audiometric tests by the occupational health physician.

Barr staff with diagnosed standard threshold shifts will be notified in writing of the shift. When the shift is first detected, the employee will be called in for subsequent testing to confirm the shift. Following confirmation of the shift, the occupational health physician will counsel the employee on the need for subsequent referral. The Barr health and safety staff will counsel the employee on the need for hearing protection and review requirements with the affected employee.

### 6.0 Noise Monitoring

Barr health and safety staff or project team members may perform noise monitoring of representative projects and equipment to determine the need for noise control procedures and/or protective equipment for Barr staff working on similar projects or with similar equipment. Barr staff will be informed of personal representative noise monitoring results.

When noise monitoring is performed at a project site, input from Barr staff on-site will be obtained. Generally, sites are small enough that Barr staff can easily observe monitoring activity. Following collection of data, the results and monitoring protocol will be reviewed with on-site project personnel.

### 7.0 Posting of Occupational Noise Exposure Standard

A copy of the Occupational Noise Exposure Standard (29 CFR 1910.95) will be included in the PHASP or posted by a project team member at any site where Barr staff may be exposed to noise levels in excess of 85 dBA (8-hour TWA).

Water and Ice  
// Safety Program

AR307608

Appendix J: Water and Ice Safety Program

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6.0	Work on Frozen Bodies of Water	J-3

Figures

Figure J-1 Depth-Velocity Flood Danger Level Relationship for Adults



## Appendix J: Water and Ice Safety Program

### 1.0 Policy

The nature of Barr's work requires that, from time-to-time, Barr employees will have to work in and near lakes, streams, and wetlands. Work during winter months may also require that employees work on frozen water bodies. It is the policy of the company to provide for the safety of its employees who must work in such conditions through training, reference materials, careful project planning, providing proper equipment, and empowering its employees to make personal decisions regarding the safety of any specific work site. No Barr employee is expected to place him/herself or another person in an unsafe situation or a situation where they are unsure as to their safety regardless of the perceived importance of the work. Employees are expected to withdraw from any unsafe or uncertain circumstances and to contact the Project Manager, Principal in Charge, and/or the Company Health and Safety Manager to request assistance before proceeding further with the work.

### 2.0 Work Near or Over Deep Water

Barr staff working on dams, bridges or other structures over water, where they may be exposed to the risk of falling into the water, shall be provided with and use U.S. Coast Guard approved Type I, II or III personal floatation devices (PFDs). Selection of appropriate PFD will depend on specific circumstances; if uncertain, contact Health & Safety staff. Ring buoys should be available at the site, positioned no more than 100 feet from the work area. At least one life-saving boat shall be available at locations where employees are working near or over water in the event that rescue is needed (*Appendix K, Boat Safety*).

### 3.0 Buddy System Related to Water and Ice Safety

A "Buddy System" for purposes of water and ice safety means having another person nearby who can see you working, who is capable of and equipped to help you, and who has agreed to do so in an emergency. The person need not necessarily be another Barr employee. The need for a "Buddy" is determined by the specific site conditions and the nature of the work. Knowledge of conditions at the worksite is important in making such decisions.

Project managers are expected to obtain sufficient information to make decisions regarding the need for a "buddy" on a field assignment. Such information might be obtained from an initial field visit to the site, from calling the client to request their input or from sending an experienced Barr staff member to view the site as a part of planning the work. To avoid budget problems, such decisions ideally need to be made in the proposal and project scoping stage of the work. Barr staff responsible for carrying out the field assignment should request guidance on this issue from the project manager. If, when they arrive at the site, conditions do not match what was anticipated, and if they believe there is the need for a "buddy" to assist them, they are expected to call the project manager to request assistance in arranging for such help. They are not to proceed with such work until they receive proper assistance.

Use of the "Buddy System" also requires planning in terms of the skills and equipment needed to safely provide assistance. The "Buddy" is not expected to place him/herself in danger to provide such assistance. Preparing a plan of action ahead of time for addressing different potential emergency situations should enable him/her to provide such assistance safely. However, it is also important to have a backup strategy available including knowledge of emergency telephone numbers, locations for medical assistance, etc.

#### 4.0 Working Alone in or Near Shallow Water

When project circumstances require a Barr employee to work in or near shallow water without a "buddy", (see Section 3.0, Buddy System Related to Water and Ice Safety), other safety procedures should be followed. First, the site conditions must be known to the person performing the work. The initial site visit should be made in the company of a "buddy" if the employee must enter the water to verify site conditions. Secondly, Barr staff are encouraged to prepare a work itinerary and arrange a call-in schedule with the project manager or another Barr employee when working in these situations. If the person does not call-in within a pre-arranged window of time, a procedure will be implemented to find out what has happened. While this cannot likely summon help for a short-term emergency, the procedure can bring help in other situations.

Loud horns or alarms can also be used to summon help in areas where they can be heard by other people. Barr has such horns available. They are light-weight and can be attached to a belt. If a person will be working in a remote area, having a portable phone nearby is also advisable.

Barr staff who will be working alone in or near shallow water must have completed a training course in water safety. Barr will rely on the training, experience, and judgement of such staff members to prepare to do such work safely and to avoid situations that they regard to be unsafe.

#### 5.0 Work in Shallow Water

The primary safety concerns associated with working in shallow water (less than four feet in depth) relate to slipping or falling, and from being carried in currents to deeper water and drowning. Barr staff are expected to anticipate the conditions they may encounter on such worksites and bring appropriate equipment with them to work safely. If site conditions are unknown, check with the project manager or principal in charge. If site information is not available, a reconnaissance visit to the site may be needed to properly plan the work. (See Section 3.0, Buddy System Related to Water and Ice Safety.)

In still waters like lakes, the condition of the bottom will likely be the determining factor regarding a hazard. An uneven bottom or a bottom with slippery rocks or drop offs can cause falls. A soft and muddy bottom, particularly with dense weeds, can also cause falls. Such hazards are also compounded by the need to carry equipment. With a solid bottom, waders may be appropriate. However, with a soft and weedy bottom, waders can be a hazard if the person falls. Weather permitting, a swimming suit or old pair of jeans along with some inexpensive tennis shoes may be a better choice. In colder weather, a wetsuit or drysuit may be needed. The same may apply to uneven or slippery areas. In many cases, a life jacket may be appropriate.

Moving water adds to the potential hazards described above. Streamflow, cross-currents and undertows can make work in even shallow water potentially dangerous. Work near culverts and storm drains can potentially be dangerous since vortex and other rotational flows near such structures can carry a person into areas where they can become trapped due to the forces involved. Areas downstream of dams and spillways can be particularly dangerous due to such rotational flows and undercurrents. Barr employees are not to work in such potentially hazardous areas without a special safety plan addressing the hazards and without prior approval by the principal in charge responsible for the work.

## 5.1 Water Velocity

For work in shallow streams in areas that are free of the above described hazards, Figure J-1 is presented as a guide to staff in deciding whether to enter a stream. As noted, this figure was obtained from a publication of the U.S. Department of Interior Bureau of Reclamation addressing concerns related to dam breaks. A curve has also been added to the figure representing the often referred to "rule of 9" (a rule of thumb indicating it is dangerous to be in water where the product of the depth times velocity equals 9). Note that this curve falls into what is called the "High Danger Zone". It should be viewed as a limit above which a person cannot reasonably stand in a stream and not as a guide for safety in working in the stream. As indicated, the middle shaded area refers to the "Judgement Zone". Barr staff are expected to use caution and good judgement in deciding to enter an area of a stream with depth and velocity in this zone. Again, bottom conditions and the amount of equipment to be carried will be a determining factor. Barr staff are expected to avoid working in portions of a stream with depth and velocity in the "High Danger zone" without preparation of a plan for safely doing so and prior discussion and approval of the PIC responsible for the work.

## 5.2 Personal Floatation Devices (PFDs)

U.S. Coast Guard approved PFDs may be required in certain cases of working in shallow water. PFD use should be addressed on a site-specific basis with the project manager.

## 6.0 Work on Frozen Bodies of Water

Barr staff may periodically have to work on a frozen lake, marsh or stream. The strength or load bearing capacity of ice is quite variable and, therefore, caution is required to prevent accidents.

The Minnesota Department of Natural Resources (MDNR) has developed information concerning safety on frozen lakes and streams. Referencing research by the U.S. Army Cold Regions Research and Engineering Laboratory, the MDNR indicates that the following factors each influence the strength of ice:

- ice thickness
- daily temperature
- snow cover
- water depth under ice
- size of water body
- age of ice
- how ice was formed
- distribution of loading
- water chemistry
- presence of decaying vegetation
- water current

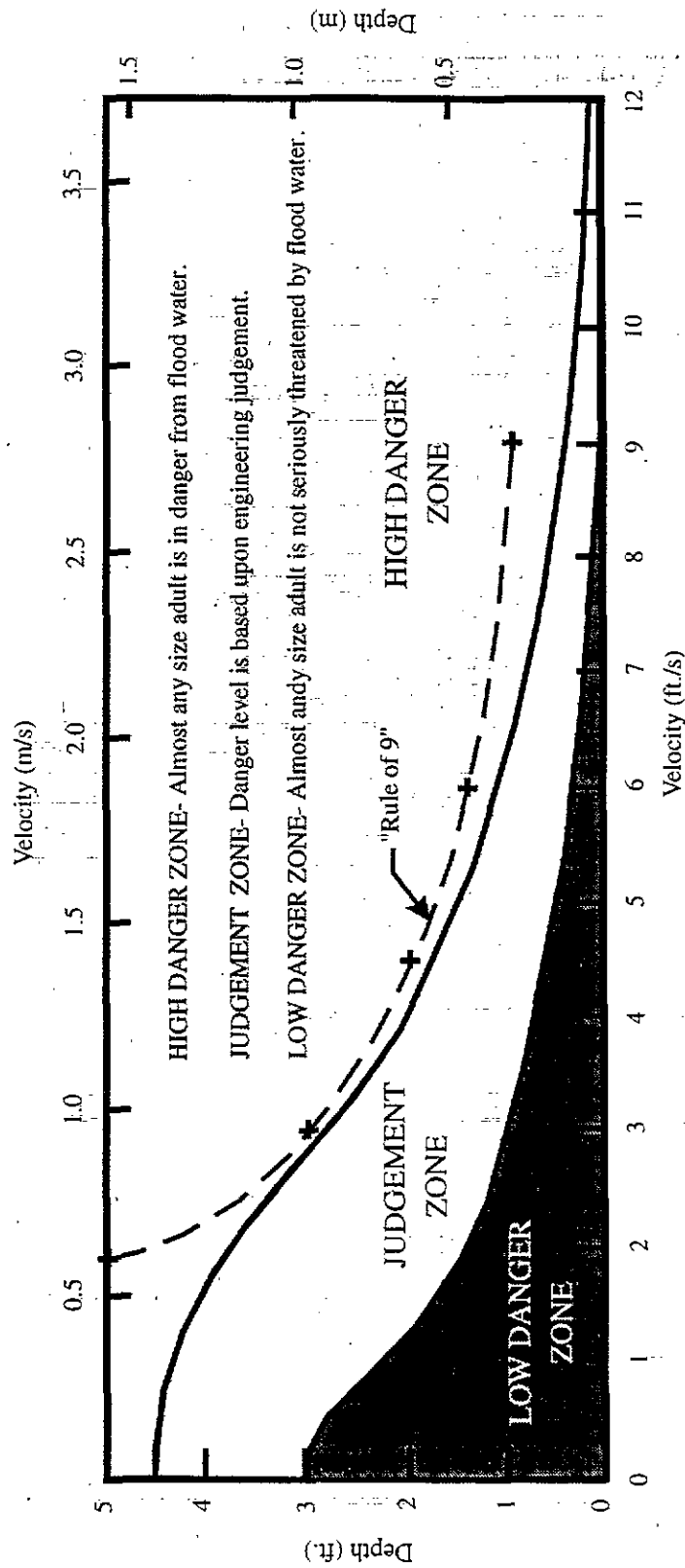
Therefore, it is difficult to predict the strength of ice, particularly over a large area. Ice thickness can vary, due to site-specific conditions. Work on rivers and streams requires special attention to safety. Localized flows near bridges and other structures, around trees and "deadheads", and near streams or springs can cause thin ice. There is also concern related to falling through the ice in areas with under-ice currents. A copy of an MDNR brochure is available from the Health and Safety staff which provides more detailed information concerning ice properties and recommended procedures in the event of breaking through the ice.

The following guidelines and practices apply to Barr employees who must work on frozen water bodies:

1. Use the "Buddy System" whenever required to work on ice unless the "known" water depth is less than four feet. Also use buddy system if working on ice over a stream with significant under ice current (1 fps or more). If working alone, follow the procedure described in Section 4.0 above.
2. Before heading out onto ice, check with local people who are familiar with the water body (bait shop owners, ice fishermen, the local sheriff, police or fire department, etc.) Ask about any known hazards or areas to avoid.
3. When entering onto a frozen water body, check the ice depth as you proceed, using an ice chisel or ice auger. Do not proceed if:
  - the ice is less than three inches thick when walking alone on foot
  - the ice is less than five inches thick when using a snowmobile
  - there is standing water on the ice
  - the ice is visibly cracked, thawing or breaking up
4. It is Barr's policy that staff not drive cars or trucks onto frozen water bodies.
5. If you must carry a significant amount of equipment with you, consider pulling a toboggan. If walking to the work site is not practical, consider renting a snowmobile with an accompanying sled or toboggan. Check the ice carefully along the planned route, and operate the snowmobile in accordance with all state and local laws. Snowmobile speed affects ice safety.
6. Anticipate the worst case (breaking through the ice), and bring along equipment, blankets and dry clothing to meet such emergencies. These items should not be brought out onto the water body, but rather left in the car or truck, assuming it is reasonably nearby in the event of an emergency. If working on ice over water deeper than four feet, wear a Coast Guard approved personal floatation device (PFD) under your outer clothing. The MDNR also recommends that people carry two short lengths of sawed-off broom handle with sharpened nails on the ends, connected by a piece of nylon string. If a person falls through the ice, the handles can be driven into the ice and used to pull him/herself forward and up onto safe ice. Rather than stand up at this point, the person is advised to roll away from the broken ice.
7. If a person falls through the ice, after assisting them to safety, help them to a warm dry place. Depending on the period of time they have been in the water, emergency medical care may be needed. Hypothermia is a dangerous and potentially life threatening condition. Additional information concerning hypothermia, expected survival times for different water temperatures, and related first aid is available from the Health and Safety staff. Cold stress is described in Section 3.16 of Appendix B: HAZARD EVALUATION.

***FIGURE J-1***

AR307614



From: Acer Technical Memorandum No. 11 Downstream Hazard Classification Guidelines U.S. Dept. of Interior-Bureau of Reclamation December, 1988

Figure J-1

DEPTH-VELOCITY FLOOD DANGER LEVEL RELATIONSHIP FOR ADULTS

AR307615

AR307616

# Appendix K: Boat Safety Program

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## Forms

Form K-1 Boat Safety Checklist



## Appendix K: Boat Safety Program

### 1.0 Policy

The nature of Barr's business requires that Barr employees periodically work on rivers, lakes, and wetlands in boats and other watercraft. It is the policy of Barr to provide for the safety of employees who work on such projects through training, careful planning, providing equipment, and through empowering employees to make personal judgements as to the safety of their work situations. Barr employees working in boats and other watercraft must have completed a training course in boating safety. Employees are also expected to perform all such work in accordance with state and federal requirements related to boating. A boat safety checklist should be completed and reviewed with the project team prior to performing this work activity. Barr employees are **not** expected to place themselves, or another person, in an unsafe situation or a situation where they are unsure as to their safety, regardless of the perceived importance of the work.

### 2.0 Boat Safety Checklist

The Boat Safety Checklist (Form K-1) identifies a number of potential site hazards associated with working in watercraft. The checklist also asks an employee to identify ahead of time (to the best of his/her ability) the action to be taken in several potential emergency situations. The purpose of the checklist is to prompt the employee(s) involved in working on water to anticipate hazardous situations that could be encountered and to have an emergency response in mind if the condition develops. Individual copies of the Boat Safety Checklist are available from the Health and Safety Staff for use on individual projects.

Barr employees are encouraged to prepare a work itinerary and arrange a call-in schedule with the project manager or another Barr employee.

### 3.0 Buddy System Related to Boat Safety

A "Buddy System" for purposes of boat safety means having another person nearby who can see you working, who is capable of and equipped to help you, and who has agreed to do so in an emergency. The second person or "buddy" can either be in the boat or on shore. However, if the second person is to be on shore, he/she must have continuous communication with the person in the boat (e.g., walkie-talkie or close enough to talk and hear), and he/she must also have a clear view of the person, the boat, and the area around the boat (approximately 200 yards). The purpose is to enable the person on shore to keep the person in the boat informed as to what is occurring around him/her and warn them of any hazards. Depending upon the specific river environment and the potential hazards nearby, a third person may also be needed. The person need not necessarily be another Barr employee. The need for a "Buddy" is determined by the specific site conditions and the nature of the work. Knowledge of conditions at the worksite is important in making such decisions.

Project managers are expected to obtain sufficient information to make decisions regarding the need for a "buddy" on a field assignment. Such information might be obtained from an initial field visit to the site, from calling the client to request their input or from sending an experienced Barr employee to view the site as a part of planning the work. To avoid budget problems, such decisions ideally need to be made in the proposal and project scoping stage of the work. Barr employee responsible for carrying out the field assignment should request guidance on this issue from the project manager. If, when they arrive at the site, conditions do not match

what was anticipated, and if they believe there is the need for a "buddy" to assist them, they are expected to call the project manager request assistance in arranging for such help. They are not to proceed with such work until they receive proper assistance.

Use of the "Buddy System" also requires planning in terms of the skills and equipment needed to safely provide assistance. The "Buddy" is not expected to place him/herself in danger to provide such assistance. Preparing a plan of action ahead of time for addressing different potential emergency situations should enable him/her to provide such assistance safely. However, it is also important to have a backup strategy available including knowledge of emergency telephone numbers, locations for medical assistance, etc.

#### 4.0 Minnesota Personal Floatation Device Requirements

Every person on board a boat or watercraft will wear or have readily accessible a U.S. Coast Guard approved Type I, II or III personal floatation device (PFD).

#### 5.0 Federal Personal Floatation Device (PFD) Requirements

Every person on board boats less than 16 feet long will wear or have readily accessible a U.S. Coast Guard approved Type I, II or III PFD.

In addition, boats 16 feet or longer in length will have at least one U.S. Coast Guard approved throwable Type IV PFD. This may be either a buoyant cushion or a ring buoy.

#### 6.0 Navigation Requirements

- Navigation lights must be on from sunset to sunrise. They shall consist of:
  - Nonmotorized Boats: Whether underway or at anchor, the boat must have a white lantern or flashlight strong enough that other boats can see it from around the horizon at a distance of two miles or more.
  - Motorboats (less than 40 feet long): When underway, must have:
    - 225 degree combination red and green bow light
    - 360 degree white light
  - When at anchor, only one 360 degree white light is necessary.
- Motorboats less than 26 feet long require one B-I marine fire extinguisher.
  - All fire extinguishers must be Coast Guard approved, fully charged, and readily accessible. Two sizes of marine fire extinguishers are available: B-I and B-II.
- Motorboats 16 feet to less than 26 feet long.

- A hand, mouth, or power-operated whistle or horn capable of producing a continuous sound for two seconds and audible for at least one-half mile is required.

## 7.0 Accidents

If involved in an accident or are a witness to one, follow these steps.

- The law requires that boaters stop and assist others in trouble if it can be done safely. Do not risk your life or the lives of others.
- Do not put yourself or others at risk in order to save equipment.
- Dial 911 or use a boat radio to summon help.
- The law requires that if involved in an accident with another watercraft, that information on names and boat numbers be exchanged with the other operator or owner.
- If the accident involves property damage exceeding \$500 or if there is a personal injury or fatality, the law requires that the accident be promptly reported to the county sheriff.

## 8.0 Boating Restrictions

Some Minnesota waters have local restrictions as to type and size of watercraft or motor horsepower, boat speeds, times for use, and minimum distance between boats. Restrictions are usually posted at public access points.

## 9.0 Renting Watercraft

The rental agent is required to provide Coast Guard approved PFDs in serviceable condition as well as other required safety equipment such as navigation lights, fire extinguishers, and whistle or horns.

The watercraft must be in safe condition. All paddles and oars must be free of cracks, splits, and breaks.

All rental water craft must have enough buoyancy to support the craft if it capsizes.

The rental operator should explain how to operate the boat motor and how to troubleshoot if the motor will not start.

All licenses and boat stickers must be in order.

## 10.0 Waterway Markers

All official waterway markers such as signs, buoys, lights, etc., are designed to mark unsafe areas, direct traffic through safe channels, prevent accidents, and to protect resources. No private markers or buoys may be placed in Minnesota waters overnight without

obtaining a permit from the county sheriff. The Health and Safety staff has available a small card prepared by the MDNR showing standard inland waterway markers.

## 11.0 Boat Trailers

### 11.1 Dimensions

The maximum length of a boat trailer, including its load and towing unit, is 65 feet. No trailer load may exceed 8.5 feet in width or 13.5 feet in height.

### 11.2 Lights

Tail lights are required. Signal and brake lamps are recommended on all trailers and required if the hand signals of the driver of the signals of the towing vehicle are not visible to the following driver.

### 11.3 Driving

The driver towing a trailer must maintain a distance of 500 feet between his or her vehicle and the vehicle ahead.

### 11.4 Brakes, Hitch and Coupling

The brakes must be in good condition. The hitch and coupling of the trailer must meet state standards. Safety chains are required.

### 11.5 Eurasian Water Milfoil (EWM) and Other Weeds and Organisms

Remember to remove all weeds (particularly Eurasian Water Milfoil) from trailer and boat prior to exiting boat ramp. There are substantial fines for transporting EWM from a water body. There are also fines for transporting other types of noxious weeds and organisms as well. Information concerning these other species is available from the Health and Safety staff.

## 12.0 Weather

### 12.1 Summer Storms

Weather is a major safety concern of boaters, and it can change suddenly. No boater should start out in a storm. There are a number of good sources of weather information. Before setting out, check local television and radio stations, call the Weather Forecast (612/375-0830), read the forecast in the newspaper, or call the nearest National Weather Service office (612/725-6090).

### 12.2 Spring and Fall Conditions

Work in a boat or other watercraft during spring and fall conditions introduces the potential risks associated with hypothermia if a person falls into the water. The Health and Safety staff have information available, developed by the Minnesota Department of Natural Resources, which presents facts relating to "hypothermia" (the loss of enough body heat to lower the body temperature to a

dangerous level). The risk varies with water and air temperature, as well as with the time spent in the water and/or cold air. Survival times can range from a fraction of an hour to several hours, depending on water temperature, a person's activities in the water and the clothing or special equipment they are wearing. Employees who find it necessary to work in boats and other watercraft during cold weather (cold water) conditions should obtain copies of the information available concerning hypothermia and incorporate appropriate procedures and equipment into their boating safety plan.

### 13.0 Work on Rivers and Streams

#### 13.1 Normal Flow Conditions

Barr employees may periodically have to work in boats and other watercraft on rivers and streams. Moving water introduces the potential for a variety of boating hazards that might not exist on still waters. A stream current carries the boat and its occupants toward continuously changing conditions, some of which could be hazardous. Therefore, such work requires continuous attention to surrounding conditions, and a second person or buddy is required (see Section 3.0, Buddy System Related to Boat Safety). Depending upon the specific river environment and the potential hazards nearby, a third person may also be needed. Helmets may also be required for certain flowing water conditions. Cold stress is described in Section 3.16 of Appendix B: HAZARD EVALUATION.

#### 13.2 Flood Conditions

Periodically, Barr's projects may require working on or near a river or stream during flood stage. Such conditions can produce potentially serious hazards. Higher flow velocities occur along with turbulence, the presence of logs, ice and other debris. The combination could potentially capsize and sink smaller watercraft. There is also the potential for the boat to get caught in debris, particularly around bridge piers and other structures, which could make it difficult to escape. A buddy is required for work on or near a river or stream during flood stage (see Section 3.0, Buddy System Related to Boat Safety). Helmets may also be required during flood stage.

Barr employees should first investigate alternative methods for accomplishing the work before proceeding to work in a boat during flood conditions. If no reasonable alternative is available, including postponing the work, Barr employees are to proceed only after preparing a boat safety checklist that addresses the potential flood safety hazards and after receiving approval of the plan by the principal in charge responsible for the project. The principal in charge may delegate such review and approval to another Barr employee who has the required experience in working on and around flood waters. Even with such pre-approval, employees are expected to evaluate the safety of the stream at the work site and, if safety conditions appear questionable or different from those anticipated in preparation of the safety plan, they should not proceed. They should telephone the project manager, the principal in charge or the person who reviewed and approved the boat safety checklist to discuss the next course of action. No Barr employee is expected to place himself, herself or another person in a dangerous situation, regardless of the perceived importance of the work.

#### 13.3 High Velocity Flows

The forces associated with flowing water are proportional to the stream velocity. Water flowing in rivers and streams at velocities in the range of 5 to 6 feet per second or faster should be regarded as potentially dangerous, even if it occurs without flooding conditions. If the boat's motor fails and the boat becomes turned sideways in the flow, it has the potential to be capsized if it strikes a fixed object. An anchor line might be used in such a situation to try to keep the boat headed into the current. However, working in a boat in such

stream velocities should be avoided, and a special safety plan and approval of the principal in charge responsible for the project is required similar to work during flood conditions.

#### 13.4 Tugboats

When encountering a tugboat, remember the following:

- Stay clear of tugboats. They usually have the right-of-way over recreational boats, and they create strong waves.
- Never anchor (*without the engine running*) in their course, they may require a half-mile or more to stop.
- At night their lights appear far apart compared to small boats.
- They have a "blind area" directly in front of the barges.
- Stay clear of the stern of tugboats. They may suddenly turn on a burst of power that could potentially overturn a small boat.
- Turn your bow into the wake of barges and boats.
- When meeting a tugboat and barge at a bend in the river, move to the inside of the bend where possible.

#### 13.6 Wing Dams

To help improve the navigability of the Mississippi and other rivers by controlling the direction of channel flow, the U.S. Army Corps of Engineers has placed numerous wing dams in navigable rivers.

A wing dam is an elongated pile of rocks, concrete, or other materials extending out from the shore, often perpendicular to the flow, and typically submerged and not marked. They are often placed along a river on the outside of river bends for the purpose of keeping the major portions of the flow in a main navigation channel. They can extend to 100 feet or more into the river. Because wing dams often lie just below the water surface, they typically cannot be visually detected and can pose a danger to the unwary boater. If these boating practices are followed, submerged wing dams may be avoided.

- When moving, stay within the main channel, indicated by buoys and markers. The main channel is regularly dredged and maintained to provide relatively hazard-free boating.
- If approaching shore, proceed slowly from a perpendicular angle.
- Navigation charts showing approximate locations of wing dams may be available for the area from the Corps of Engineers and can sometimes be purchased at map stores.
- Stay clear of ripples in the water surface, these are tell-tale signs of a wing dam or other obstruction lying just below.

### 13.7 Locks and Dams - Restricted Areas

There are certain restricted areas to protect boaters in the vicinity of locks and dams. Boats *may not enter* the following areas without preparation of a special safety plan. If it is necessary to be closer, special safety measures may need to be taken.

- The area 600 feet upstream and 150 feet downstream from a dam (*including auxiliary locks not in service*).
- The area 600 feet upstream from a spillway.

Additional restrictions may be posted at each dam or spillway. Obey all signs.

FORM K-1  
BOAT SAFETY CHECKLIST

Project Name \_\_\_\_\_ Project Number \_\_\_\_\_  
Barr On-Site Employees \_\_\_\_\_ Proposed Date of Work \_\_\_\_\_  
Date of Preparation \_\_\_\_\_ Reviewed Date \_\_\_\_\_  
Barr Health & Safety Team Leader \_\_\_\_\_  
Objective (describe work activity) \_\_\_\_\_

Site Description \_\_\_\_\_

Any Boating Restriction on the Water Body? \_\_\_\_\_

POTENTIAL SITE HAZARDS (check all that you think may apply\* and comment on how these potential site hazards may be avoided)

- ☐ Difficult Access (steep bank, severe drop-off, cliffs, unstable slopes, private property)
- ☐ Dead Heads (tree stumps, rocks, submerged obstacles)
- ☐ Debris in Water (trees, garbage, waste)
- ☐ Weedbanks
- ☐ Existence of Dams, Spillways, Large Storm Drain Outlets, etc., near work area
- ☐ Turbulent Water, Swift Undercurrents, Submerged Stormwater Outlets
- ☐ Unfavorable Water Bottom Conditions (bog, mud, sedgeweed, soft bottom, quick conditions)
- ☐ Overhead Hazards (tree branches, falling objects from bridges)
- ☐ Adverse Weather (thunderstorms, lightning, rain, wind)
- ☐ Structural Hazards (piers, bridges, submerged wing dams)
- ☐ Vegetation, Brush Growth
- ☐ Overhead/Underwater Powerlines or Cables
- ☐ Water Traffic (pleasure crafts, barges, boats)
- ☐ Heat Stress
- ☐ Cold Stress (potential for hypothermia)
- ☐ Boat Decontamination Necessary

Comments on potential hazards: \_\_\_\_\_

\*If uncertain, check with someone who has visited the site (PM, PIC, client, etc.)



## Boat Safety Checklist (continued)

ANTICIPATED WATER CONDITIONS/BOAT SPECIFICATIONS

Air Temperature	_____
Water Temperature	_____
Water Velocities *	_____
Water Depth	_____
Boat Speed Limit	_____
Motor Size	_____
Boat Type	_____
Rated Boat Capacity (no. of people & equipment)	_____
Anchor (type)	_____
Kill Switch Available	_____
Gas Requirements (mixed/unmixed)	_____
Water Traffic Control	_____
Coast Guard Notification	_____
Water Speed Limit	_____

\* Special care required when stream velocities exceed 4 feet per second.

TELEPHONE NUMBERSContactPhone #

County Sheriff	_____	_____
Boat Rental Company	_____	_____
Corps of Engrs.- Lock/Dams	_____	612-290-5619
MN Coast Guard	_____	612-290-3991
Project Manager	_____	(W) _____
		(H) _____
Weather Forecast (Twin Cities)	_____	612-375-0830
National Weather Service	_____	612-725-6090
River Stage Information	_____	612-290-5861

FACILITIES NEARBY (if yes, indicate location)Location

Potable Water Supply	Yes <input type="checkbox"/>	No <input type="checkbox"/>	_____
Telephone	Yes <input type="checkbox"/>	No <input type="checkbox"/>	_____
Bathrooms	Yes <input type="checkbox"/>	No <input type="checkbox"/>	_____
Hospital	Yes <input type="checkbox"/>	No <input type="checkbox"/>	_____

If no, indicate action plan: \_\_\_\_\_

EMERGENCY PROCEDURES

(anticipated action plan if any of the following emergency potentials exist)

- Engine Quits \_\_\_\_\_
- Hole in Boat \_\_\_\_\_
- Boat Capsizes \_\_\_\_\_
- Person Overboard \_\_\_\_\_
- Illness/Injury On Board \_\_\_\_\_

## Boat Safety Checklist (continued)

EQUIPMENT NEEDS

- ☐ Communication Equipment (marine radio, mobile phone)
- ☐ Floatation Devices (PFDs - one per person on boat)
- ☐ Throwable Buoyant Cushion or Ring Buoy
- ☐ Throw Bags
- ☐ First-Aid Kit
- ☐ Extra Fuel
- ☐ Extra Rope
- ☐ Pike Pole or Boat Hook
- ☐ Bilge Pump or Bailing Devices
- ☐ Tool Kit
- ☐ Flashlight
- ☐ Wisconsin requires a battery box or nonconductive cover for battery terminals
- ☐ Heater for cold weather conditions, blankets, etc.

Boat rental company should supply the following equipment. Barr watercraft should have the following equipment:

- |  |   |
|--|---|
| <input type="checkbox"/> Oars, Paddles         | <input type="checkbox"/> Horn/Whistles                        |
| <input type="checkbox"/> Anchor(s) and Line(s) | <input type="checkbox"/> Auxiliary Outboard Motor             |
| <input type="checkbox"/> Fire Extinguisher     | <input type="checkbox"/> Ring Buoys (90-foot line for rescue) |
| <input type="checkbox"/> Lights                |   |

PERSONAL EQUIPMENT

- |                    |       |                    |       |
|--------------------|-------|--------------------|-------|
| Nonslip Boat Shoes | _____ | Rain Gear          | _____ |
| Sunscreen          | _____ | Change of Clothing | _____ |
| Safety Glasses     | _____ | Hard Hat           | _____ |
| Gloves             | _____ | Insect Repellent   | _____ |

FLOAT PLAN (provide information to Project Manager prior to boat departure)

1. Description of Boat

Length Overall \_\_\_\_\_ (Feet)  
 Color \_\_\_\_\_  
 Manufacturer \_\_\_\_\_  
 Registration No. \_\_\_\_\_  
 Boat Name \_\_\_\_\_

## Boat Safety Checklist (continued)

2. Trip Plan

Departure Time \_\_\_\_\_ Location \_\_\_\_\_ ☐ Upriver  
 (Date/Time) (From) ☐ Downriver  
 Estimated Return Time \_\_\_\_\_

3. Vehicle

Parking Location \_\_\_\_\_  
 Description and License of Vehicle \_\_\_\_\_

*L* Hazardous Materials  
Program

AR307628

Appendix L: DOT Hazardous Material Shipping Program

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2.0	Regulation Overview	L-1
3.0	Barr Program	L-2

## Appendix L: DOT Hazardous Material Shipping Program

## 1.0 Overview

In CFR 49, the Federal Department of Transportation has spelled out in detail its program and requirements for the shipping of hazardous materials. At Barr, a hazardous material to be shipped may include the following: samples from sites such as contaminated soils or product, sampling bottles with preservatives, Hermit dataloggers, and compressed gases.

In addition to very specific requirements for shipping hazardous materials, the regulations have also spelled out specific training and certification requirements for employees involved in hazardous materials shipping. The purpose of this program is to address both the practical shipping requirements and the training requirements. The program goals also enable project personnel to comply with federal regulations regarding hazardous materials shipping without project delays as a result of shipping.

## 2.0 Regulation Overview

The following is a brief summary of the DOT Hazardous Material Shipping requirements.

## 2.1 Training Requirements

In Subpart H—Training, of CFR 49, Part 172, all hazmat employees who, in the course of employment, directly affect hazardous materials shipping, must have training provided at least once every two years. Hazmat employees are defined as anyone who handles, prepares paperwork, packages, offers the package for shipment, or is in anyway involved with presenting hazardous materials for shipment. training is to include the following:

- *General awareness/familiarization training* designed to provide familiarity with the requirements and enable the employee to recognize and identify hazardous materials shipping concerns.
- *Function-specific training* concerning the requirements which specifically apply to the function the employee performs.
- *Safety training* concerning emergency response information, measures to protect the employee from the hazards of hazardous materials, and methods for avoiding accidents involving hazardous materials.
- *Driver training* which is only applicable if driving vehicles containing materials requiring placarding.

Training is to be provided within 90 days after employment or after a job change, and at least once every two years thereafter. Records of training must be kept for length of employment plus 90 days. Records need to contain the following information:

1. Employee name.
2. Most recent training completion date.
3. A description, copy, or location of training materials used.
4. Name and address of person providing training.
5. Certification that employee has been **trained and tested**.

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## 2.2 General Program Requirements

The DOT hazardous materials shipping regulations address several very specific areas regarding shipping in great detail. In general, these areas are as follows:

- *Determine applicability of DOT hazardous material shipping regulations using available data from project team and literature sources, then comparing data to regulations.*

If the material to be shipped falls under DOT Hazmat regulations, then the following steps are taken based on the information provided in CFR 49 or, when relevant, the International Air Transport Association (IATA) Dangerous Goods Regulations.

1. *Select the proper shipping description for the material being shipped (e.g., proper shipping name, hazard class or classes, proper UN/NA identification numbers)*
2. *Determine and select the proper packaging(s)*
3. *Mark, label, and/or placard the package(s)*
4. *Prepare all appropriate shipping papers*
5. *Conduct appropriate vehicle pretreatment activities (e.g., loading, blocking, bracing)*
6. *Hazardous wastes/hazardous substances rules need to be checked for applicability in addition to DOT regulations*

## 3.0 Barr Program

### 3.1 Training

Training for *general awareness/familiarization* will be provided in conjunction with the annual eight-hour OSHA refresher course. The general awareness training is presented in a combination live presentation/video tape format and will include, as required by DOT, testing on the information provided. It is anticipated that this aspect of training will take the employees being trained one hour to complete.

Training for *function-specific* areas will be provided for each individual project hazardous material shipping event. All persons involved in the shipping for the project will be trained. The function-specific training will be conducted by a Barr employee who has been trained by an outside training group in the application of DOT Hazardous Material Shipping regulations. A memo will be prepared for the project based on the material involved, and this memo will be discussed in detail with the employees involved with shipping. A testing and certification step will be included in the memo and kept with training records. It is anticipated that this training aspect will take the employees being trained 10 to 30 minutes to complete, depending on the complexity of the shipping requirements for that project.

Safety training will be provided using both OSHA training and presentation of emergency response information during the one-hour general awareness/familiarization training.

No additional *driver's training* is planned. It is not anticipated that Barr employees will be driving placarded vehicles. In general, Commercial Driver's License (CDL) with HM/tank vehicle endorsement may be needed.

### 3.2 General Program

Prior to preparing the memo for function specific training on a specific project, a number of steps are necessary to determine whether the material is hazardous, what special shipping requirements are needed, what exemptions apply, and what are the specific project needs. The process for preparing to ship a hazardous material is outlined below.

1. The project team contacts a hazardous materials shipping person.
2. One of the hazardous material shipping persons will gather technical information from both the project team and available resources. Information to be gathered includes, but is not limited to:
  - Nature of the material: what is known from past investigations, are there any laboratory data available, what was the source of the material.
  - Shipping needs: where the material is to be shipped, in what quantities, when does it need to be shipped, is it necessary to keep the material cool, is quick delivery essential, does it need to travel by air.
  - Specific chemical, safety, and toxicological data may also be collected to better evaluate the shipping needs.

The hazardous materials shipping person will then determine whether the material is considered hazardous by DOT standards and what proper shipping description applies.

3. Specific shipping requirements regarding packaging, labeling, marking, placarding, and shipping documents will be determined.
4. Packaging materials will be located and ordered.
5. A project specific/event specific memo will be prepared detailing all steps to be completed prior to shipping the material.
6. Training, testing and certification of the employees to perform the shipping will take place upon completion of the project specific/event specific memo. The training will be conducted by one of the hazardous material shipping persons. At the time of training any necessary labels, placards, or shipping papers may be provided. Shipping documents will be as complete as possible prior to actual shipping. Additional information may need to be entered on the documents at the time of shipping.
7. Decisions made regarding the shipping determinations for the project will be documented and held in the project file.
8. Any feedback provided by the shippers on problems or difficulties encountered will be reviewed and the shipping process improved as appropriate.

### 3.3 Other Considerations

Several materials which fall within DOT Hazardous Materials Shipping regulations are routinely shipped or transported by Barr employees, including the Hermit data loggers and preserved sample bottles sent from environmental laboratories. A memo will be prepared and training will be provided for these routine items as appropriate.

It is necessary to provide whatever lead time is possible to minimize project delays. In many cases, specific shipping materials need to be ordered for the shipping event.

***M***/Motor Vehicle  
Operation Program

AR307633



Appendix M: Motor Vehicle Operation Program

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Forms

Form M-1 Motor Vehicle Accident Report

## Appendix M: Motor Vehicle Operation

### 1.0 Policy

Barr employees operating motor vehicles on company business are expected to operate these vehicles in a safe manner and in accordance with state and federal requirements.

### 2.0 Passengers of Motor Vehicles

Barr employees are **not** allowed to ride in the back of pick-up trucks, or vans without back seats, on heavy equipment, or in any other vehicle not designed to carry passengers and not equipped with seat belts for each passenger. Barr employees will carry passengers in appropriate seats with seat belts.

### 3.0 Vehicle Condition

It is the responsibility of the vehicle operator to make sure that the vehicle is in safe working condition. The driver should verify that the following items are functional:

- turn indicators
- head lights and brake lights
- mirrors
- horn
- windshield wipers and washer
- tires (wear and proper inflation)

### 4.0 Safety Equipment

First aid and winter survival kits are available in the safety equipment room. First aid kits and fire extinguishers are equipped in the Barr vehicles.

### 5.0 Parking on or Near Public Roads

It may be necessary at times to park at the side of a public roadway. If it is necessary to park at the side of a roadway, traffic control devices (e.g., traffic cones or reflective triangles) will be placed to warn traffic and to designate traffic control zones.

Whenever work conducted in Minnesota affects vehicular or pedestrian traffic, the publication "Traffic Control for Short Term Street or Highway Work Zones, Appendix B," should be used to aid in providing proper traffic control. The purpose of traffic control is to provide safe and effective work areas and to warn, control, protect, and expedite vehicular and pedestrian traffic.

For daytime work, orange or fluorescent red/orange clothing such as a vest is required for all workers working on the right-of-way and not separated from traffic by a physically protective barrier such as concrete barriers or fixed guardrails.

## 6.0 Vehicle Use on Frozen Bodies of Water

Under no circumstances will cars or trucks be driven onto frozen bodies of water. Snowmobiles may be driven onto the ice if the driver has verified that the ice is at least five (5) inches thick and that ice conditions are otherwise acceptable (refer to Appendix J: WATER AND ICE SAFETY).

## 7.0 Motor Vehicle Accident Reporting

### 7.1 Vehicles Owned, Leased, or Rented by Barr

Any accident involving a motor vehicle owned, leased, or rented by Barr will be reported to the Company Health and Safety Manager as soon as possible.

### 7.2 Personal Vehicle Operated on Barr Business

Any accident involving a personal motor vehicle operated on company or project business should be reported to the Company Health and Safety Manager within 24 hours. If any injury to a Barr employee or third party arises from the accident, the Company Health and Safety Manager should be notified immediately.

### 7.3 Steps To Follow If Involved In An Accident

If involved in an accident while on company business, the following steps should be followed:


1. Stop the vehicle and determine damage. If safe to do so, pull out of traffic. If vehicle must be exited, try not to exit into traffic.
2. Place emergency signals to warn on-coming traffic.
3. Aid any injured parties and call for medical assistance.
4. Notify Barr Engineering Co.
5. Complete the Motor Vehicle Accident Report Form (Form M-1). Return completed form to Company Health and Safety Manager upon return to office.
6. Get names, addresses, and telephone numbers of witnesses.
7. Make no statements of guilt or admissions of blame.

## Motor Vehicle Operation

8. Make no statements other than your name, address, insurance information, and driver's license number to any party other than:

- the police
- Barr Health and Safety and Management
- Representatives of your or Barr's insurance company

# **FORM M-1** **MOTOR VEHICLE ACCIDENT REPORT** (Complete and Return to Health & Safety Manager)

Date of Accident _____ 19__		Day of Week _____		Hour _____ a.m. _____ p.m.																													
<input type="checkbox"/> CITY <input type="checkbox"/> SUBURBAN <input type="checkbox"/> RURAL		PLACE WHERE ACCIDENT OCCURRED County _____ City, town _____ or township _____																															
If accident was outside the city limits, indicate distance from nearest town. Use two distances and two directions, if necessary.		{ _____ miles _____ north-south _____ miles _____ east-west		of { <input type="checkbox"/> limits of _____ <input type="checkbox"/> center of _____ City or town																													
ROAD ON WHICH ACCIDENT OCCURRED _____ Give name of street or highway number (U.S. or State)																																	
<input type="checkbox"/> AT ITS INTERSECTION WITH _____ Name of intersecting street or highway number																																	
OR																																	
<input type="checkbox"/> NOT AT INTERSECTION (Check and complete one)																																	
{ _____ feet _____ north-south _____ feet _____ east-west																																	
of _____ Show nearest intersecting street or highway, house number, curve, bridge, rail crossing, alley, driveway, culvert, mile underpass, numbered telephone pole, or other identifying landmark. Show exact distance, using two directions and two distances, if necessary.																																	
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ADDRESS _____																																	
CITY _____		STATE _____		DRIVER'S LICENSE NO. _____																													
OTHER VEHICLE OWNER'S NAME _____																																	
ADDRESS _____																																	
CITY _____		STATE _____		VEHICLE LICENSE NO. _____																													
TYPE VEHICLE _____		MAKE _____		YEAR _____																													
DAMAGE TO OTHER VEHICLE AND/OR PROPERTY _____																																	
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POLICE Name _____ Badge No. _____																																	
WITNESSES (Name, Address, Phone Number) _____																																	
INDICATE ON THIS DIAGRAM WHAT HAPPENED <div style="text-align: center;">   INDICATE NORTH BY ARROW  SHOW POSITION OF VEHICLES </div>																																	
DRIVER'S SIGNATURE _____																																	

N/ Training Program

AR307639

Appendix N: Training Program

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## Appendix N: Training Program

### 1.0 Initial and Annual Training

All Barr employees and Barr's subcontractors working on site will have attended the 40-hour initial training for work on hazardous waste sites, have kept current with an 8-hour refresher annually, and have had at least three days of supervised on-site training. In addition, any Barr employee acting as the Barr on-site representative has had an additional 8 hours of supervisor training. These training requirements are required by the OSHA standard, 29 CFR 1910.120 Hazardous Waste Operation and Emergency Response.

All Barr employees who visit the site only occasionally for performance of limited tasks, have attended a 24-hour training session and have kept current with an 8-hour refresher, and have had at least one day of supervised on-site training.

### 2.0 Training Documentation

Each Barr employee on site will be issued a training certificate and a training documentation card that indicates the type of training received, the training organization and the date training was received. Copies of all training certificates are kept on file at Barr's office. Training documentation cards are to be carried with Barr employees on site.

### 3.0 Training Content

The content of initial training and refresher training includes recognition of the signs and symptoms of overexposure to chemical and physical hazards, proper use of personal protective equipment, decontamination procedures, air monitoring equipment usage, recognition of physical hazards, medical surveillance requirements, and PHASPs. Company specific safety concerns may also be covered at the annual refresher training.



Medical Surveillance  
Program

AR307642

# Appendix O: Medical Surveillance Program

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## Appendix O: Medical Surveillance Program

### 1.0 Overview

All Barr Engineering employees with 40-hour training participate in a medical surveillance program that meets the requirements of 29 CFR 1910.120 (f). These employees carry a Medical Examiner's Certificate (Green Card) that indicates they have received and passed a medical examination before entering the project site and are medically able to wear a respirator. Barr's subcontractors also participate in a medical surveillance program that meets the requirements of 29 CFR 1910.120 (f). Barr's subcontractors are required to provide Barr with proof of medical surveillance prior to initiation of the project.

All Barr Engineering employees involved in field activities have been trained in the recognition of symptoms and signs that might indicate over-exposure to physical or chemical hazards during their initial 24/40-hour training and during annual 8-hour refresher training.

### 2.0 Baseline Medical Surveillance

Baseline medical evaluations are provided without cost to employees with 40-hour training, prior to working on or near sites covered by the Barr Health and Safety Policy Manual. The baseline evaluation includes a medical and work history with special emphasis on symptoms related to the handling of hazardous substances and health hazards. Special emphasis is placed on fitness for duty, including the ability to wear any required personal protective equipment under conditions that may be expected at a work site. The Baseline Medical Surveillance exam is classified as 'Protocol A' and is normally conducted in two phases. The first phase includes medical history, vital signs, vision screening, blood profile including complete blood count and blood chemistry, heavy metal blood screen for lead, mercury and arsenic, urinalysis, pulmonary function consisting of FVC, FEV, FEV1, resting EKG, single view chest x-ray, and audiometry. The second phase includes physician review of the lab results and a physical examination.

### 3.0 Periodic Medical Surveillance

Periodic medical surveillance is conducted either annually or biannually for all employees with 40-hour training and who have worked on or near hazardous waste operations or intend to work on or near hazardous waste operations in the upcoming year. The attending occupational physician is responsible for determining the appropriate medical surveillance monitoring period. The periodic medical evaluation is classified as 'Protocol B' and is given in two phases. The first phase includes lab work, annual review of medical history, vital signs, vision screening, blood profile including complete blood count and blood chemistry, heavy metal screen for lead, mercury and arsenic, urinalysis, pulmonary function consisting of FVC, FEV, FEV1, and audiometry. The second phase includes physician review of the lab results and physical examination.

### 4.0 Site-Specific Medical Surveillance

In the event that Barr employees will be working on or near hazardous waste operations, and the medical examination protocols established are not specific for hazardous substances that may be encountered on that site, additional medical evaluations will be performed on an individual basis to be determined by the attending physician. Additionally, in the event that the attending physician determines that the medical evaluation frequency should be increased, medical examinations will be performed as recommended.

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## 5.0 Exposure/Injury/Medical Support

In the event that notification reveals that an employee has possibly been overexposed to hazardous substances or health hazards above the PEL or other published exposure level, has been injured, or has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, an additional medical evaluation will be performed as soon as possible. The content of this examination will be determined by the attending physician who has been advised of the possible overexposure. The Barr Project Health and Safety Team Leader should facilitate emergency care as described in SECTION 2: EMERGENCY ACTION PLAN of the PHASP and the Project Manager should be notified after the emergency is abated.

## 6.0 Termination Medical Evaluation

Upon termination of employment with Barr or upon reassignment to work within the company that does not involve working on or near hazardous waste operations, a medical evaluation is conducted and is classified as 'Protocol D'. This examination may include an annual medical history, vital signs, vision screening, blood profile including complete blood count and blood chemistry, heavy metal blood screen for lead, mercury and arsenic, urinalysis, pulmonary function consisting of FVC, FEV, FEV1, and audiometry. The content of this examination will be determined by the attending physician.

## 7.0 Information Provided to Physician

Barr has provided Occupational Medicine Consultants and its attending physicians with a copy of the Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) and its appendices. Job descriptions for Barr employees, measured and anticipated employee exposure levels, personal protective equipment used, and information from previous medical examinations are also provided to Occupational Medicine Consultants and its attending physicians.

## 8.0 Recordkeeping

Barr receives a written physician's opinion for all medical evaluations from the examining physician, documenting that the employee is qualified to work on or near hazardous waste operations and to wear respiratory protection equipment. The employee receives a copy of this written physician's opinion, copies of laboratory results, a confidential letter from the examining physician on results of the medical evaluation, and a medical information card (green card) that certifies medical qualification to work and to wear respiratory protective equipment while on hazardous waste sites and summarizes emergency medical information.

All medical records are confidentially maintained at the office of the attending physician and are made available to employees or their designee upon written request. The written physician's opinion indicating an employee's suitability to work in hazardous waste operations and their physical ability to wear respiratory protective equipment is maintained at Barr's office.

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## Appendix P: Material Safety Data Sheets

## 1.0 Scope

Materials Safety Data Sheets (MSDS) are included in this section for all hazardous substances that may be brought on site by Barr employees. Barr's Hazard Communication (Employee Right-to-Know) program is described in the Barr Health and Safety Policy Manual and has not been duplicated in the PHASP.

MSDS in this Appendix include:

- a) Buffer Solution, pH 7.0 Color Coded Yellow
- b) Buffer Solution (pH 10.00) Blue
- c) Compressed breathing air (Grade D or better)
- d) Durabond Tri-sodium phosphate cleaner
- e) Gasoline (lead-free)
- f) Hexane
- g) Hydrochloric Acid
- h) Hydrogen Sulfide Calibration Gas (Industrial Scientific HS267 H<sub>2</sub>S Monitor)
- i) Isobutylene Calibration gas (HNu; Thermo OVM)
- j) Liqui-nox (anionic liquid detergent)
- k) Methane Calibration gas (Foxboro OVA)
- l) Methane, carbon dioxide, balance air calibration gas (Land Tec GA-90 landfill gas monitor)
- m) Methyl Alcohol (methanol)
- n) MSA Cleaner Sanitizer II (Respirator cleaning powder)
- o) MSA P/N 478191 Calibration gas (MSA 260/360; MSA Microgard)
- p) Nitric Acid
- q) Personal Safety Equipment Cleaning Pad (Respirator Wipe Pad)
- r) Propane
- s) Sodium Hydroxide Solution
- t) Sulfur Dioxide Calibration Gas (Industrial Scientific SO261 SO<sub>2</sub> Monitor)
- u) Sulfuric Acid
- v) YSI 3682 Zobell Solution (Redox Calibration Solution)
- w) YSI 3167 Conductivity Calibration 1,000 microns/cm (Conductivity Calibration Solution)

AR307647

\*\*BUFFER SOLUTION PH 7.0 COLOR CODED YEL  
 \*\*BUFFER SOLUTION PH 7.0 COLOR CODED YEL  
 \*\*BUFFER SOLUTION PH 7.0 COLOR CODED YEL

## MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC  
 CHEMICAL DIVISION  
 1 REAGENT LANE  
 FAIR LAWN NJ 07410  
 (201) 796-7100

EMERGENCY NUMBER: (201) 796-7100  
 CHEMREC ASSISTANCE: (800) 424-9300

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## SUBSTANCE IDENTIFICATION

SUBSTANCE: \*\*BUFFER SOLUTION PH 7.0 COLOR CODED YELLOW\*\*

TRADE NAMES/SYNONYMS:  
 SBI07

CHEMICAL FAMILY:  
 Mixture, aqueous

CERCLA RATINGS (SCALE 0-3): HEALTH=U FIRE=0 REACTIVITY=0 PERSISTENCE=0  
 NFPA RATINGS (SCALE 0-4): HEALTH=U FIRE=0 REACTIVITY=0

## COMPONENTS AND CONTAMINANTS

COMPONENT: POTASSIUM PHOSPHATE MONOBASIC CAS# 7778-77-0	PERCENT: 0.7
COMPONENT: SODIUM HYDROXIDE CAS# 1310-73-2	PERCENT: 0.1
COMPONENT: YELLOW FOOD COLOR	PERCENT: 0.02
COMPONENT: WATER	PERCENT: 99.0

OTHER CONTAMINANTS: NONE.

## EXPOSURE LIMITS:

No occupational exposure limits established by OSHA, ACGIH, or NIOSH.

## PHYSICAL DATA

DESCRIPTION: Liquid. BOILING POINT: 212 F (100 C) (water)  
 MELTING POINT: 32 F (0 C) (water) SPECIFIC GRAVITY: 1.0 (water)  
 VAPOR PRESSURE: 14 mmHg @ 20 C (H2O) PH: 7.0 @ 25 C  
 SOLUBILITY IN WATER: soluble

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FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:

Negligible fire hazard when exposed to heat or flame.

FIREFIGHTING MEDIA:

Extinguish using agent suitable for type of surrounding fire.

FIREFIGHTING:

No acute hazard. Move container from fire area if possible. Avoid breathing vapors or dusts; keep upwind.

TOXICITY

CARCINOGEN STATUS: None.

ACUTE TOXICITY LEVEL: No data available.

TARGET EFFECTS: No data available.

HEALTH EFFECTS AND FIRST AID

INHALATION:

ACUTE EXPOSURE- This solution has not been tested. However, no hazardous effects are expected due to the low concentration of the component(s).

CHRONIC EXPOSURE- No data available.

FIRST AID- It is unlikely that emergency treatment will be required. If adverse effects occur, remove from exposure, treat symptomatically and supportively, and get medical attention.

SKIN CONTACT:

ACUTE EXPOSURE- This solution has not been tested. However, no hazardous effects are expected due to the low concentration of the component(s).

CHRONIC EXPOSURE- No data available.

FIRST AID- It is unlikely that emergency treatment will be required. If adverse effects occur, proceed with the following: Wash with soap or mild detergent and large amounts of water. Get medical attention.

EYE CONTACT:

ACUTE EXPOSURE- This solution has not been tested. However, no hazardous effects are expected due to the low concentration of the component(s).

CHRONIC EXPOSURE- No data available.

FIRST AID- It is unlikely that emergency treatment will be required. If adverse effects occur, proceed with the following: Wash with large amounts of water or normal saline until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:

ACUTE EXPOSURE- This solution has not been tested. However, no hazardous effects are expected due to the low concentration of the component(s).

CHRONIC EXPOSURE- No data available.

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FIRST is unlikely that emergency treatment will be required. If adverse effects occur, proceed with the following: Treat symptomatically and supportively, Get medical attention.

REACTIVITY

REACTIVITY:  
Stable under normal temperatures and pressures.

INCOMPATIBILITIES:  
No data available.

DECOMPOSITION:  
None/hazardous.

POLYMERIZATION:  
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

STORAGE AND DISPOSAL

Observe all federal, state and local regulations when storing or disposing of this substance.

CONDITIONS TO AVOID

No reports found.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:  
Soak up spill with vermiculite or other absorbent material and place into suitable containers for later disposal.

PROTECTIVE EQUIPMENT

VENTILATION:  
Provide local exhaust or general dilution ventilation system.

RESPIRATOR:  
Based on the components present and/or information in physical data, health effects or toxicity sections, no respirator would be required under the normal conditions of use. However, air contamination monitoring should be carried out to assure that the employees are not exposed to harmful concentrations of any of the above mentioned components.  
If respiratory protection is required, it must be based on the contamination levels found in the workplace, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

**CLOTHING:**

Protective clothing not required. Avoid repeated or prolonged contact with this substance.

**GLOVES:**

Protective gloves are not required but recommended.

**EYE PROTECTION:**

Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

AUTHORIZED - FISHER SCIENTIFIC, INC.

CREATION DATE: 04/15/91

REVISION DATE: 06/07/95

**-ADDITIONAL INFORMATION-**

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AR307651

\*\*BUFFER SOLUTION, (PH 10.00) BLUE\*\*  
\*\*BUFFER SOLUTION, (PH 10.00) BLUE\*\*  
\*\*BUFFER SOLUTION, (PH 10.00) BLUE\*\*

## MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC  
CHEMICAL DIVISION  
1 REAGENT LANE  
FAIR LAWN, NJ 07410  
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100  
CHEMREC ASSISTANCE: (800) 424-9300

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## SUBSTANCE IDENTIFICATION

SUBSTANCE: \*\*BUFFER SOLUTION, (PH 10.00) BLUE\*\*

TRADE NAMES/SYNONYMS:

SB 115

CHEMICAL FAMILY:

Mixture, aqueous

GHS RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=0  
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=0 REACTIVITY=0

## COMPONENTS AND CONTAMINANTS

COMPONENT: ETHYLENEDIAMINETETRAACETIC ACID, DISODIUM SALT PERCENT: 1.0  
CAS# 139-33-3

COMPONENT: POTASSIUM CARBONATE PERCENT: 0.6  
CAS# 584-08-7

COMPONENT: POTASSIUM BORATE PERCENT: 0.4  
CAS# 12228-88-5

COMPONENT: POTASSIUM HYDROXIDE PERCENT: 0.2  
CAS# 1310-58-3

COMPONENT: BLUE FOOD COLOR PERCENT: 0.02

COMPONENT: WATER PERCENT: 98.0

OTHER CONTAMINANTS: NONE

## EXPOSURE LIMITS:

No occupational exposure limits established by OSHA, ACGIH, or NIOSH.

## PHYSICAL DATA

DESCRIPTION: Blue liquid. BOILING POINT: not available

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SPECIFIC GRAVITY: not available      VAPOR PRESSURE: not available      PAGE 02 OF 05  
SOLUBILITY IN WATER: not available      PH: 10.0

#### FIRE AND EXPLOSION DATA

##### FIRE AND EXPLOSION HAZARD:

Negligible fire hazard when exposed to heat or flame.

##### FIREFIGHTING MEDIA:

Extinguish using agent suitable for type of surrounding fire.

##### FIREFIGHTING:

No acute hazard. Move container from fire area if possible. Avoid breathing vapors or dusts; keep upwind.

#### TOXICITY

##### ETHYLENEDIAMINETETRAACETIC ACID, DISODIUM SALT:

###### TOXICITY DATA:

ANHYDROUS: 2 gm/kg oral-rat LD50; 2300 mg/kg oral-rabbit LD50; 2050 mg/kg oral-mouse LD50; 56 mg/kg intravenous-mouse LD50; 47 mg/kg intravenous-rabbit LD50; 260 mg/kg intraperitoneal-mouse LD50; mutagenic data (RIECS); reproductive effects data (RIECS).

DIHYDRATE: Mutagenic data (RIECS).

CARCINOGEN STATUS: None.

LOCAL EFFECTS: Irritant- eye.

ACUTE TOXICITY LEVEL: Moderately toxic by ingestion.

TARGET EFFECTS: Poisoning may affect the kidneys.

AT INCREASED RISK FROM EXPOSURE: Persons with renal or heart disease; a history of seizures or intracranial lesions; potassium deficiency; or insulin-dependent diabetes.

ADDITIONAL DATA: Parenteral administration of EDTA or its salts in high doses may cause severe renal lesions and tubular necrosis, internal hemorrhage, life-threatening hypocalcemia, and death. Prolonged parenteral administration may lead to electrolyte imbalance, and cardiac arrhythmias.

#### HEALTH EFFECTS AND FIRST AID

##### INHALATION:

###### ETHYLENEDIAMINETETRAACETIC ACID, DISODIUM SALT:

ACUTE EXPOSURE- No specific data available. Inhalation of dusts or mists of EDTA salts may cause mucous membrane irritation with sore throat and coughing.

CHRONIC EXPOSURE- No data available.

FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

##### SKIN CONTACT:

###### ETHYLENEDIAMINETETRAACETIC ACID, DISODIUM SALT:

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ACUTE EXPOSURE- No specific data available. EDTA salts may cause irritation with redness and pain.  
 CHRONIC EXPOSURE- Repeated or prolonged contact with EDTA salts may cause moderate irritation and possibly a mild burn.

FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

#### EYE CONTACT:

ETHYLENEDIAMINETETRAACETIC ACID, DISODIUM SALT:  
 IRRITANT.

ACUTE EXPOSURE- Contact with EDTA salts may cause irritation with redness, pain, and some transient corneal injury.

CHRONIC EXPOSURE- Repeated or prolonged contact with EDTA salts may cause conjunctivitis.

FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

#### INGESTION:

ETHYLENEDIAMINETETRAACETIC ACID, DISODIUM SALT:

ACUTE EXPOSURE- Solutions of the salts of EDTA are extremely irritating to the gastrointestinal system. Although poorly absorbed, if sufficient amounts are ingested systemic toxicity may result. EDTA and its salts may chelate lead, magnesium, zinc, and trace metals if they are present in the intestine, possibly causing their increased absorption and thereby increasing total body stores of these metals.

CHRONIC EXPOSURE- In feeding studies, rats fed a diet of 5 and 10% EDTA disodium salts for up to 13 weeks showed decreased food consumption and weight gain when compared to controls. These rats also suffered from diarrhea and priapism. A 60% mortality occurred in the 10% diet group, and 20% mortality in the 5% group. Reproductive effects have been reported in animal studies.

FIRST AID- If vomiting occurs, keep head lower than hips to help prevent aspiration. Treat symptomatically and supportively. Get medical attention if needed.

#### REACTIVITY

##### REACTIVITY:

Stable under normal temperatures and pressures.

##### INCOMPATIBILITIES:

ETHYLENEDIAMINETETRAACETIC ACID, DISODIUM SALT:  
 OXIDIZERS (STRONG): Fire and explosion hazard.

##### DECOMPOSITION:

Thermal decomposition may release toxic and/or hazardous gases.

##### POLYMERIZATION:

Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

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STORAGE AND DISPOSAL

Observe all federal, state and local regulations when storing or disposing of this substance.

Storage

Store away from incompatible substances.

CONDITIONS TO AVOID

No reports found.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:

Soak up spill with vermiculite or other absorbent material and place into suitable containers for later disposal.

Reportable Quantity (RQ):

The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity established for that substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:

Provide local exhaust or general dilution ventilation system.

RESPIRATOR:

The following respirators are recommended based on information found in the physical data, toxicity and health effects sections. They are ranked in order from minimum to maximum respiratory protection. The specific respirator selected must be based on contamination levels found in the work place, must be based on the specific operation, must not exceed the working limits of the respirator and must be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

Any chemical cartridge respirator with an organic vapor cartridge(s)

Any gas mask with organic vapor canister (chin-style or front- or back-mounted canister).

Any type 'C' supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode.

Any self-contained breathing apparatus.

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FOR FIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITION

MSDS-111-1111 INDEX OF USE

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

**CLOTHING:**

Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

**GLOVES:**

Employee must wear appropriate protective gloves to prevent contact with this substance.

**EYE PROTECTION:**

Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

AUTHORIZED: FISHER SCIENTIFIC, INC.

CREATION DATE: 04/15/91

REVISION DATE: 10/25/94

**-ADDITIONAL INFORMATION-**

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LIQUID AIR CORPORATION  
INDUSTRIAL GASES DIVISION

## Material Safety Data Sheet

<b>PRODUCT NAME</b> Compressed Air		
<b>TELEPHONE (415) 977-6500</b> <b>EMERGENCY RESPONSE INFORMATION ON PAGE 2</b>		
<b>LIQUID AIR CORPORATION</b> INDUSTRIAL GASES DIVISION One California Plaza, Suite 350 2121 N. California Blvd. Walnut Creek, California 94596	<b>TRADE NAME AND SYNONYMS</b> See last page.	<b>CAS NUMBER</b> N/A
	<b>CHEMICAL NAME AND SYNONYMS</b> Air	
<b>ISSUE DATE</b> OCTOBER 1, 1985 <b>AND REVISIONS</b> CORPORATE SAFETY DEPT	<b>FORMULA</b> See note on last page.	<b>MOLECULAR WEIGHT</b> 28.966 <b>CHEMICAL FAMILY</b> N/A

### HEALTH HAZARD DATA

#### TIME WEIGHTED AVERAGE EXPOSURE LIMIT

None listed (ACGIH, 1984-85).

#### SYMPTOMS OF EXPOSURE

Air is nontoxic and necessary to support life. Inhalation of air in a high pressure environment such as underwater diving, caissons or hyperbaric chambers can result in symptoms similar to overexposure to pure oxygen. These include tingling of fingers and toes, abnormal sensations, impaired coordination and confusion. Decompression sickness pains or "bends" are possible following rapid decompression.

#### TOXICOLOGICAL PROPERTIES

High pressure effects (greater than two atmospheres of oxygen) are on the central nervous system. Improper decompression results in the accumulation of nitrogen in the blood.

Listed as Carcinogen  
or Potential Carcinogen

National Toxicology  
Program Yes ☐  
No ☒

I.A.R.C.  
Monographs Yes ☐  
No ☒

OSHA Yes ☐  
No ☒

#### RECOMMENDED FIRST AID TREATMENT

Facilities or practices at which air is breathed in a high pressure environment should be prepared to deal with illnesses associated with decompression (Bends or Caisson Disease). Decompression equipment may be required.

Judgements as to the suitability of information herein for purchaser's purposes are necessary purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of this information, Liquid Air Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or availability of such information for application to any intended purposes or consequences of its use. Since Liquid Air Corporation has no control over the use of this product, it assumes no liability for damage or loss of product resulting from or (unproper) use or application of the product. Data Sheets may be changed from time to time. Be sure to consult the latest edition.



N/A

## PHYSICAL DATA

BOILING POINT -317.9°F (-194.4°C)	LIQUID DENSITY AT BOILING POINT 54.70 lb/ft <sup>3</sup> (876.21 kg/m <sup>3</sup> )
VAPOR PRESSURE @ 70°F (21.1°C) above the critical temperature of -220.4°F (-140.2°C)	GAS DENSITY AT 70°F 1 atm .0749 lb/ft <sup>3</sup> (1.200 kg/m <sup>3</sup> )
SOLUBILITY IN WATER @ 68°F (20°C) Bunsen coefficient = .0183	FREEZING POINT N/A; BUDDIE POINT @ 1 ATM. = -317.8°F (-194.35°C)
APPEARANCE AND ODOR Colorless, odorless gas. Specific gravity @70°F (Air = 1.0) is 1.0.	

## FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED)	AUTO IGNITION TEMPERATURE	FLAMMABLE LIMITS % BY VOLUME
N/A	N/A	N/A
EXTINGUISHING MEDIA	ELECTRICAL CLASSIFICATION	
Nonflammable gas	Nonhazardous	
SPECIAL FIRE FIGHTING PROCEDURES		
N/A		
UNUSUAL FIRE AND EXPLOSION HAZARDS		
Compressed air at high pressures will accelerate the burning of materials to a greater rate than they burn at atmospheric pressure.		

## REACTIVITY DATA

STABILITY Unstable	CONDITIONS TO AVOID	
Stable	X	
INCOMPATIBILITY (Materials to avoid) None		
HAZARDOUS DECOMPOSITION PRODUCTS None		
HAZARDOUS POLYMERIZATION May Occur	CONDITIONS TO AVOID	
Will Not Occur	X	

## SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED  N/A
WASTE DISPOSAL METHOD  N/A

## EMERGENCY RESPONSE INFORMATION

IN CASE OF EMERGENCY INVOLVING THIS MATERIAL, CALL DAY OR NIGHT (800) 231-1366  
OR CALL CHEMTREC AT (800) 424-9300

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# RESPIRATORY PROTECTION (50000) (1990)

VENTILATION N/A	LOCAL EXHAUST N/A	SPECIAL
	MECHANICAL (Gen.) N/A	OTHER

## PROTECTIVE GLOVES

Any material

## EYE PROTECTION

Safety goggles or glasses

## OTHER PROTECTIVE EQUIPMENT

Safety shoes

## SPECIAL PRECAUTIONS\*

### SPECIAL LABELING INFORMATION

DOT Shipping Name: Air, compressed      DOT Hazard Class: Nonflammable gas  
DOT Shipping Label: Nonflammable gas      I.D. No.: UN 1002

### SPECIAL HANDLING RECOMMENDATIONS

Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3,000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

For additional handling recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.

### SPECIAL STORAGE RECOMMENDATIONS

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130F (54C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time.

For additional storage recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.

### SPECIAL PACKAGING RECOMMENDATIONS

Dry air is noncorrosive and may be used with all materials of construction. Moisture causes metal oxides which are formed with air to be hydrated so that they increase in volume and lose their protective role (rust formation). Concentrations of SO<sub>2</sub>, Cl<sub>2</sub>, salt, etc. in the moisture enhances the rusting of metals in air.

### OTHER RECOMMENDATIONS OR PRECAUTIONS

Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).

\*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which may not be contained herein. The customer or user of this product should be familiar with these regulations.

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ADDITIONAL DATA

TRADE NAME AND SYNONYMS: (Continued)

Air; Compressed Air; Compressed Air, Breathing Quality

NOTE: Atmospheric air which is compressed is composed of the following concentrations of gases:

<u>Gas</u>	<u>Molar %</u>
Nitrogen	78.09
Oxygen	20.94
Argon	0.93
Carbon Dioxide	0.033*
Neon	$18.18 \times 10^{-4}$
Helium	$5.239 \times 10^{-4}$
Krypton	$1.139 \times 10^{-4}$
Hydrogen	$0.5 \times 10^{-4}$
Xenon	$0.086 \times 10^{-4}$
Radon	$6 \times 10^{-18}$
Water vapor	Varying concentrations

\* Concentrations may have slight variations.

Compressed air is also produced by reconstitution using only oxygen and nitrogen. This product contains 79 molar percent nitrogen and 21 molar percent oxygen plus trace amounts of other atmospheric gases which are present in the oxygen and nitrogen.

# MATERIAL SAFETY DATA SHEET

DAP INC.  
P.O. BOX 277  
DAYTON, OHIO 45401-0277

MSDS NO: DAP / 71076  
INTERNAL ID: 71076  
DURABOND TSP CLEANER  
REVISION: 2  
DATE: JANUARY 30, 1999

NATIONAL PAINT  
AND COATINGS  
ASSOCIATION  
  
HAZARDOUS MATERIAL  
IDENTIFICATION  
SYSTEM

HEALTH HAZARD	2 - MODERATE
FLAMMABILITY HAZARD	0 - MINIMAL
REACTIVITY HAZARD	0 - MINIMAL
PERSONAL PROTECTION	8 - GLASSES, GLOVES

## SECTION I. MATERIAL IDENTIFICATION

TRADE/MATERIAL NAME: DURABOND TSP CLEANER

DESCRIPTION: EASY MIX, WALL CLEANER

FORM: MIXTURE

SDS REVISION DATE: AUGUST 13, 1990

SHIPPING NAME (49 CFR 172.101): NA

DOT ID NO. (49 CFR 172.101): NA

DOT LABEL REQUIRED (49 CFR 172.101): NA

HAZARD CLASS - IF DISCARDED (40 CFR 261): NONE

FACTURER: DAP INC.  
P.O. BOX 277  
DAYTON, OH 45401-0277

PHONE: 1-800-543-3840  
IN OHIO 1-513-667-4461

## SECTION II. INGREDIENTS AND HAZARDS

INGREDIENT NAME:	CAS NUMBER:	PERCENT:	EXPOSURE LIMITS:
SODIUM SULFATE	7757-82-6	40-50	10 MG/M3
SODIUM SESQUICARBONATE	533-96-0	30-40	NE
TRISODIUM PHOSPHATE	7601-54-9	10-20	NE

REMAINING INGREDIENTS ARE NOT REGULATED BY OSHA AND ARE CONSIDERED TRADE SECRETS

## SECTION III. PHYSICAL DATA

APPEARANCE & ODOR: WHITE CRYSTALLINE POWDER

BOILING POINT: NA

VAPOR PRESSURE: NA

WATER SOLUBILITY (%): APPRECIABLE

VAPOR DENSITY (AIR=1): NA

EVAPORATION RATE: NA

SPECIFIC GRAVITY (H2O=1): 1.6

% VOLATILE BY VOLUME: NA

WATER LESS WATER LESS VOLATILE SOLVENT (G/LITER): 0

SOLID MATERIAL (G/LITER): 0

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MATERIAL SAFETY DATA SHEET

DAP INC.  
P.O. BOX 377  
DAYTON, OHIO 45401-0277

MSDS NO: DAP / 71076  
INTERNAL ID: 71076  
DURABOND TSP CLEANER  
REVISION: 2  
DATE: JANUARY 30, 1991

SECTION IV. FIRE AND EXPLOSION DATA

FLASH POINT (METHOD): NONE                      LIMITS: LEL %: NA                      UEL %: NA  
EXTINGUISHING MEDIA: USE PROPER MEDIA FOR CAUSE OF FIRE. USE WATER SPRAY,  
MECHANICAL FOAM, CARBON DIOXIDE OR DRY CHEMICAL.  
USUAL FIRE OR EXPLOSION HAZARDS: SULFUR OXIDE GASSES MAY BE EMITTED AT HIGH  
TEMPERATURES.  
SPECIAL FIRE-FIGHTING PROCEDURES: USE WATER SPRAY TO COOL EXPOSED SURFACES. WEAR  
SELF-CONTAINED BREATHING APPARATUS.

SECTION V. REACTIVITY DATA

MATERIAL IS STABLE. HAZARDOUS POLYMERIZATION WILL NOT OCCUR.  
CHEMICAL INCOMPATIBILITIES: REACTS WITH ACIDS. DO NOT MIX WITH BLEACH, VINEGAR,  
OTHER ACIDS.  
CONDITIONS TO AVOID: EXCESSIVE HEAT  
HAZARDOUS DECOMPOSITION PRODUCTS: CARBON DIOXIDE; SULFUR OXIDE FUMES.

SECTION VI. HEALTH HAZARD INFORMATION

THIS PRODUCT IS NOT CONSIDERED A CARCINOGEN BY THE NTP, IARC AND OSHA.  
MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED BY CONTACT: ASTHMATIC CONDITIONS MAY  
WORSEN FROM PROLONGED AND  
CONTINUOUS EXPOSURE.  
PRIMARY ENTRY ROUTE(S): SKIN CONTACT.  
ACUTE EFFECTS: MAY CAUSE SEVERE EYE IRRITATION. MAY CAUSE MILD SKIN IRRITATION.  
IF INGESTED, WILL CAUSE IRRITATION OF MUCOUS MEMBRANES OF THE MOUTH, THROAT,  
ESOPHAGUS AND STOMACH. INHALING SMALL AMOUNTS OF DUST MAY BE VERY IRRITATING.  
CHRONIC EFFECT(S): PROLONGED EXPOSURE MAY CAUSE SERIOUS OR PERMANENT EYE DAMAGE  
AND MORE SEVERE SKIN IRRITATION.  
FIRST AID:  
EYE CONTACT: FLUSH WITH LARGE AMOUNTS OF WATER FOR 15 MINUTES.  
CONTACT A PHYSICIAN IMMEDIATELY.  
SKIN CONTACT: WASH WITH SOAP AND WATER. REMOVE CONTAMINATED  
CLOTHING. IF IRRITATION PERSISTS CALL PHYSICIANS.  
INHALATION: REMOVE TO FRESH AIR. CONTACT PHYSICIAN IMMEDIATELY.  
INGESTION: DO NOT INDUCE VOMITING. DILUTE BY GIVING SEVERAL  
GLASSES OF WATER OR MILK TO DRINK IF VICTIM IS  
CONSCIOUS. CONTACT PHYSICIAN OR REGIONAL POISON CONTROL  
CENTER.

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MATERIAL SAFETY DATA SHEET

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SECTION VII. SPILL, LEAK AND DISPOSAL PROCEDURES

SPILL / LEAK PROCEDURES: CONTAIN SPILL. PLACE INTO DRUMS FOR PROPER DISPOSAL. WASH REMAINING AREA WITH WATER TO REMOVE TRACE RESIDUE. EVACUATE UNPROTECTED PERSONNEL FROM AREA. USE PROPER SAFETY EQUIPMENT. MAINTAIN ADEQUATE VENTILATION. DO NOT DISCHARGE INTO SEWERS OR FRESH WATERS.

WASTE MANAGEMENT / DISPOSAL: DISPOSE OF ACCORDING TO FEDERAL, STATE AND LOCAL STANDARDS. DO NOT REUSE EMPTY CONTAINERS. THIS PRODUCT IS NON-HAZARDOUS ACCORDING TO U.S. EPA'S HAZARDOUS WASTE MANAGEMENT REGULATIONS.

SECTION VIII. SPECIAL PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT:

GOGGLES: SAFETY GLASSES RECOMMENDED

GLOVES: RECOMMENDED

RESPIRATOR: IF 8-HOUR EXPOSURE LIMIT OR VALUE IS EXCEEDED USE AN APPROVED NIOSH/OHSA RESPIRATOR. CONSULT YOUR SAFETY EQUIPMENT SUPPLIER AND OSHA REGULATION, 29 CFR 1910.134 FOR RESPIRATOR REQUIREMENTS.

WORKPLACE CONSIDERATIONS:

VENTILATION: PROVIDE SUFFICIENT MECHANICAL VENTILATION TO MAINTAIN EXPOSURE BELOW PEL AND TLV.

CONTAMINATED EQUIPMENT:

WASH CONTAMINATED CLOTHING BEFORE REUSE.

SECTION IX. SPECIAL PRECAUTIONS

STORAGE SEGREGATION: STORE IN A COOL WELL VENTILATED PLACE AWAY FROM ACIDS.

SPECIAL HANDLING / STORAGE: KEEP CONTAINERS TIGHTLY CLOSED WHEN NOT IN USE. KEEP OUT OF REACH OF CHILDREN. KEEP CONTAINERS FROM EXCESSIVE HEAT.

HAZARD CLASS: NONE

THIS DATA IS OFFERED IN GOOD FAITH AS TYPICAL VALUES AND NOT AS A PRODUCT SPECIFICATION. NO WARRANTY, EITHER EXPRESSED OR IMPLIED, IS HEREBY MADE. THE RECOMMENDED INDUSTRIAL HYGIENE AND SAFE HANDLING PROCEDURES ARE BELIEVED TO BE GENERALLY APPLICABLE. HOWEVER, EACH USER SHOULD REVIEW THESE RECOMMENDATIONS IN THE CONTEXT OF THE INTENDED USE AND DETERMINE WHETHER THEY ARE APPROPRIATE.

END OF MSDS 71076

— PAGE 3

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# Genium Publishing Corporation

1145 Catalyn Street  
Schenectady, NY 12303-1836 USA  
(518) 377-8854

Sheet No. 467  
Automotive Gasoline, Lead-free

Issued: 10/81

Revision: A. 9/91

## Section 1. Material Identification

**Automotive Gasoline, Lead-free, Description:** A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

**Other Designations:** CAS No. 8006-61-9, benzine, gasoline, gasolene, motor spirits, natural gasoline, petrol.

**Manufacturers:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*<sup>TM</sup> for a suppliers list.

R 1  
I 2  
S 2\*  
K 4  
\* Skin  
absorption



HMIS  
H 2  
F 3  
R 1  
PPGT  
† Sec. 8

**Cautions:** Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

## Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free\*

1990 OSHA PELs

8-hr TWA: 300 ppm, 900 mg/m<sup>3</sup>

15-min STEL: 500 ppm, 1500 mg/m<sup>3</sup>

1990-91 ACGIH TLVs

TWA: 300 ppm, 890 mg/m<sup>3</sup>

STEL: 500 ppm, 1480 mg/m<sup>3</sup>

1990 NIOSH REL

None established

1985-86 Toxicity Data\*

Man, inhalation, TC<sub>50</sub>: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)

Human, eye: 140 ppm/8 hr; toxic effects include mild irritation

Rat, inhalation, LC<sub>50</sub>: 300 g/m<sup>3</sup>/5 min

\* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.

† See NIOSH, *NIHES* (LX3300000), for additional toxicity data.

## Section 3. Physical Data

**Boiling Point:** Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)

**Vapor Density (air = 1):** 3.0 to 4.0

**Density/Specific Gravity:** 0.72 to 0.76 at 60 °F (15.6 °C)

**Water Solubility:** Insoluble

**Appearance and Odor:** A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

## Section 4. Fire and Explosion Data

**Flash Point:** -45 °F (-43 °C)

**Autoignition Temperature:** 536 to 853 °F (280 to 456 °C)

**LEL:** 1.3% v/v

**UEL:** 6.0% v/v

**Extinguishing Media:** Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.

**Unusual Fire or Explosion Hazards:** Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.

**Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.

**Conditions to Avoid:** Avoid heat and ignition sources.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

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**Section 6. Health Hazard Data**

**Carcinogenicity:** In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).

**Summary of Risks:** Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonia. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.

**Medical Conditions Aggravated by Long-Term Exposure:** None reported.

**Target Organs:** Skin, eye, respiratory and central nervous systems.

**Primary Entry Routes:** Inhalation, ingestion, skin contact.

**Acute Effects:** Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes merriment (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonia. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.

**Chronic Effects:** Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.

**FIRST AID**

**Eyes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

**Skin:** Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

**Inhalation:** Remove exposed person to fresh air and support breathing as needed.

**Ingestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard.

Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

**Section 7. Spill, Leak, and Disposal Procedures**

**Spill/Leak:** Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).

**Aquatic Toxicity:** Bluegill, freshwater, LC<sub>50</sub> 8 ppm/96 hr.

**Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**EPA Designations**

RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

**Section 8. Special Protection Data**

**Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.

**Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. **Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.**

**Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. Note: Resistance of specific materials can vary from product to product.

**Ventilation:** Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.<sup>OSHA</sup>

**Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**Contaminated Equipment:** Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

**Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

**Section 9. Special Precautions and Comments**

**Storage Requirements:** Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.

**Engineering Controls:** Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

**Transportation Data (49 CFR 172.101, 102)**

DOT Shipping Name: Gasoline (including casing-head and natural)

DOT Hazard Class: Flammable liquid

ID No.: UN1203

DOT Label: Flammable liquid

DOT Packaging Exceptions: 173.118

DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline

IMO Hazard Class: 3.1

ID No.: UN1203

IMO Label: Flammable liquid

IMDG Packaging Group: II

**MSDS Collection References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159

**Prepared by:** M Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Smart, MS

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HEXANES  
HEXANES  
HEXANES

# MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC  
CHEMICAL DIVISION  
1 REAGENT LANE  
FAIR LAWN NJ 07410  
(201) 796-7100

EMERGENCY CONTACTS:  
GASTON L. PILLORI: (201) 796-7100  
AFTER BUSINESS HOURS, HOLIDAYS:  
(201) 796-7523  
CHEMTREC ASSISTANCE: (800) 424-5300

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## SUBSTANCE IDENTIFICATION

SUBSTANCE: HEXANES

TRADE NAMES/SYNONYMS:

N-HEXANE, NCI-C60571; HEXYLHYDRIDE; NORMAL HEXANE; SKELLYSOLVE B;  
STCC 7508183; UN 1208; H-300; H-334; H-292; H-291; N-3; C6H14; ACC10951

CHEMICAL FAMILY:  
HYDROCARBON, ALIPHATIC

MOLECULAR FORMULA: C6-H14

MOLECULAR WEIGHT: 86.20

CERCLA RATINGS (SCALE 0-3): HEALTH=0 FIRE=3 REACTIVITY=0 PERSISTENCE=1  
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

## COMPONENTS AND CONTAMINANTS

COMPONENT: N-HEXANE CAS 110-54-3	PERCENT: VARIES
COMPONENT: 2-METHYLPENTANE CAS 107-83-5	PERCENT: VARIES
COMPONENT: 3-METHYLPENTANE CAS 96-14-0	PERCENT: VARIES
COMPONENT: NEOHEXANE CAS 75-83-2	PERCENT: VARIES
COMPONENT: 2,3-DIMETHYLBUTANE CAS 79-29-8	PERCENT: VARIES

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:

HEXANE:

50 PPM (120 MG/M3) OSHA TWA  
50 PPM (120 MG/M3) ACGIH TWA  
100 PPM NIOSH RECOMMENDED 10 HOUR TWA,  
510 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

HEXANE, ALL ISOMERS OTHER THAN N-HEXANE:

500 PPM (1200 MG/M3) OSHA TWA, 1000 PPM (3600 MG/M3) OSHA STEL  
500 PPM (1200 MG/M3) ACGIH TWA, 1000 PPM (3600 MG/M3) ACGIH STEL

ALKANES (C5-C8):

350 MG/M3 NIOSH RECOMMENDED 10 HOUR TWA,  
1800 MG/M3 NIOSH RECOMMENDED 15 MINUTE CEILING

## PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID, FAINT ODOR, VERY VOLATILE

BOILING POINT: 136 F (58 C) MELTING POINT: -139 F (-95 C)

SPECIFIC GRAVITY: 0.7 VAPOR PRESSURE: 124 MMHG @ 20 C

SOLUBILITY IN WATER: INSOLUBLE VAPOR DENSITY: 3.0

SOLVENT SOLUBILITY: ALCOHOL, CHLOROFORM, ETHER

## FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:

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DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

DUE TO LOW ELECTROCONDUCTIVITY OF THE SUBSTANCE, FLOW OR AGITATION MAY GENERATE ELECTROSTATIC CHARGES RESULTING IN SPARKS WITH POSSIBLE IGNITION.

FLASH POINT: -7 F (-22 C) (CC) UPPER EXPLOSIVE LIMIT: 7.5%

LOWER EXPLOSIVE LIMIT: 1.1% AUTOIGNITION TEMP.: 437 F (223 C)

FLAMMABILITY CLASS(OSHA): IS

**FIREFIGHTING MEDIA:**

DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

**FIREFIGHTING:**

MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR. NOZZLES. ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG. SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS. KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA 325M, FIRE HAZARD PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND VOLATILE SOLIDS, 1984)

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**TRANSPORTATION DATA**

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:  
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:  
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.119  
EXCEPTIONS: 49 CFR 173.118

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**TOXICITY**

**N-HEXANE:**

10 MG EYE-RABBIT MILD IRRITATION; 880 PPM EYE-HUMAN IRRITATION (35MKAJ); 190 PPM/8 WEEKS INHALATION-HUMAN TCLO; 120 CM/M3 INHALATION-MOUSE LCLO; 22,710 MG/KG ORAL-RAT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).

CARCINOGEN STATUS: NONE.

N-HEXANE IS AN EYE, MUCOUS MEMBRANE AND SKIN IRRITANT, CENTRAL NERVOUS SYSTEM DEPRESSANT AND NEUROTOXIN. POISONING MAY AFFECT THE HEART. PERSONS WITH PRE-EXISTING SKIN, LIVER, KIDNEY, AND RESPIRATORY DISEASE MAY BE AT AN INCREASED RISK FROM EXPOSURE. ALCOHOL MAY ENHANCE THE TOXIC EFFECTS. A LOW ORDER OF MYOCARDIAL SENSITIZATION TO EPINEPHRINE MAY OCCUR.

**2-METHYLPENTANE:**

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYES.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

ADDITIONAL DATA: STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

**3-METHYLPENTANE:**

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- SKIN, EYE, MUCOUS MEMBRANES.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

ADDITIONAL DATA: CONSUMPTION OF ALCOHOL MAY POTENTIATE THE TOXIC EFFECTS. USE OF STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

**NEOHXANE:**

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYES.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

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ADDITIONAL DATA: STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

**2,3-DIMETHYLBUTANE:**

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- SKIN, EYE, MUCOUS MEMBRANE.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

ADDITIONAL DATA: CONSUMPTION OF ALCOHOL MAY POTENTIATE THE TOXIC EFFECTS. USE OF STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

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**HEALTH EFFECTS AND FIRST AID**

**INHALATION:**

**N-HEXANE:**

IRRITANT/NARCOTIC/NEUROTOXIN.

5000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- 880 PPM FOR 15 MINUTES HAS CAUSED UPPER RESPIRATORY TRACT IRRITATION. AT 1400-1500 PPM SLIGHT NAUSEA AND HEADACHE ALSO OCCURRED. 5000 PPM FOR 10 MINUTES CAUSED MARKED VERTIGO. OTHER REPORTED SYMPTOMS ARE PERIPHERAL NEUROPATHY, GIDDINESS, INCOORDINATION, NUMBNESS OF THE LIMBS, ANOREXIA, PERSISTENT TASTE OF GASOLINE, CONFUSION, AND LOSS OF CONSCIOUSNESS IN EXTREME CASES. ANESTHESIA OF SHORT DURATION WITHOUT SEQUELA IS POSSIBLE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE POLYNEUROPATHY WITH SYMMETRICAL SENSORY DYSFUNCTION OF THE DISTAL PORTIONS OF THE EXTREMITIES WHICH SLOWLY PROGRESSES TO MUSCLE WEAKNESS IN THE TOES AND FINGERS AND LOSS OF DEEP SENSORY REFLEXES. THE DELAY BETWEEN EXPOSURE AND PARALYSIS MAY BE DAYS TO WEEKS. THE PROGNOSIS FOR COMPLETE RECOVERY IS GOOD, ALTHOUGH THE DISORDER MAY INTENSIFY FOR MONTHS. OTHER REPORTED SYMPTOMS INCLUDE A FEELING OF DRUNKENNESS, ANOREXIA, IMPOTENCE, MEMORY LOSS, FOOT DROP, BLURRED VISION, COLOR VISION ABNORMALITIES, MODERATE LOSS OF TOUCH, PIN PRICK, VIBRATION, AND THERMAL SENSATION, USUALLY ACCOMPANIED BY ANKLE JERKS, FACIAL NUMBNESS, COLD LEG SENSATIONS, AND GENERALIZED ACHING OF MUSCLES AND WEAKNESS OF BOTH LEGS. TESTING HAS SHOWN ELECTROMYOGRAPHIC ABNORMALITIES AND MOTOR NERVE CONDUCTION LOSS. AS THE NEUROPATHY BECOMES MORE SEVERE, NEUROGENIC ATROPHY OF SKELETAL MUSCLE MAY OCCUR. A LOW ORDER OF MYOCARDIAL SENSITIZATION TO EPINEPHRINE MAY OCCUR. EFFECTS ON THE NEWBORN HAVE BEEN REPORTED FROM REPEATED EXPOSURE AND EFFECTS ON THE MALE REPRODUCTIVE SYSTEM HAVE BEEN REPORTED FROM SINGLE EXPOSURE IN RATS.

**HEXANES (OTHER THAN N-HEXANE):**

IRRITANT/NARCOTIC.

ACUTE EXPOSURE- MAY CAUSE IRRITATION TO THE MUCOUS MEMBRANES. LIQUID ALIPHATICS, C5-C9, HAVE ANESTHETIC AND CENTRAL NERVOUS SYSTEM DEPRESSANT ACTIONS. SYMPTOMS MAY INCLUDE, BUT ARE NOT LIMITED TO, DIZZINESS, DROWSINESS, INCOORDINATION, CONVULSIONS, COLLAPSE OR COMA. SOME ISOMERANES HAVE BEEN DOCUMENTED TO SENSITIZE THE MYOCARDIUM TO EPINEPHRINE. CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO ALIPHATIC HYDROCARBONS MAY RESULT IN EFFECTS AS DESCRIBED IN ACUTE EXPOSURE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

**SKIN CONTACT:**

**N-HEXANE:**

IRRITANT.

ACUTE EXPOSURE- VAPOR MAY CAUSE IRRITATION WITH REDNESS. 2 ML/KG/4 HOURS ON RABBIT SKIN RESULTED IN ATAXIA AND RESTLESSNESS. AT 5 ML/KG/4 HOURS SOME DEATHS OCCURRED.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS DUE TO DEFATTING, BLISTER FORMATION, ITCHING, ERYTHEMA, PIGMENTATION AND PAIN HAVE BEEN REPORTED.

**HEXANES (OTHER THAN N-HEXANE):**

IRRITANT.

ACUTE EXPOSURE- MAY CAUSE IRRITATION AND BE ABSORBED THROUGH THE SKIN.

CHRONIC EXPOSURE- THE C5 AND HIGHER LIQUID ALIPHATIC HYDROCARBONS ARE FAT SOLVENTS, AND REPEATED OR PROLONGED CONTACT MAY RESULT IN DEFATTING DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

**EYE CONTACT:**

**N-HEXANE:**

IRRITANT.

ACUTE EXPOSURE- DIRECT CONTACT IN IRRITATION WITH REDNESS AND PAIN. VAPORS AT 880 PPM FOR 15 MINUTES CAUSED IRRITATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH IRRITANTS MAY CAUSE CONJUNCTIVITIS.

**HEXANES (OTHER THAN N-HEXANE):**

IRRITANT.

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ACUTE EXPOSURE- MAY CAUSE IRRITATION. MOST LIQUID HYDROCARBONS CAUSE LITTLE OR NO INJURY ON DIRECT EXTERNAL CONTACT WITH THE EYE.  
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH IRRITANTS MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE. OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

N-HEXANE:

NARCOTIC.

ACUTE EXPOSURE- MAY CAUSE CENTRAL NERVOUS SYSTEM EFFECTS. HEADACHE, NAUSEA, VOMITING, VERTIGO, BRONCHIAL AND GENERAL INTESTINAL IRRITATION WITH ABDOMINAL SWELLING AND PAIN. THE FATAL HUMAN DOSE MAY BE ABOUT 50 GRAMS. MAY VAPORIZE WHEN ASPIRATED INTO THE TRACHEOBRONCHIAL TREE WITH A RESULTANT RAPID DILUTION OF ALVEOLAR AIR AND MARKED FALL IN ITS OXYGEN CONTENT, WITH CONSEQUENT BRAIN DAMAGE OR CARDIAC ARREST.

CHRONIC EXPOSURE- NO HUMAN DATA AVAILABLE. EFFECTS ON THE EMBRYO HAVE BEEN REPORTED FROM REPEATED DOSES IN MICE.

HEXANES (OTHER THAN N-HEXANE):

NARCOTIC.

ACUTE EXPOSURE- MAY CAUSE GASTROINTESTINAL DISTURBANCES. IF SUFFICIENT AMOUNTS OF ALIPHATIC HYDROCARBONS ARE INGESTED AND RETAINED, CENTRAL NERVOUS SYSTEM DEPRESSION MAY OCCUR. SYMPTOMS MAY INCLUDE, BUT ARE NOT LIMITED TO, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, INCOORDINATION, CONVULSIONS, AND COMA. IN ANIMAL STUDIES, ASPIRATION OF 0.2 ML OF C6-C8 ALIPHATICS, CAUSED ALMOST IMMEDIATE DEATH DUE TO RESPIRATORY PARALYSIS. ASPHYXIA AND CARDIAC ARREST.

CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- EXTREME CARE MUST BE USED TO PREVENT ASPIRATION. USE GASTRIC LAVAGE WITH ACTIVATED CHARCOAL AND A CUFFED ENDOTRACHEAL TUBE WITHIN 15 MINUTES. IN THE ABSENCE OF DEPRESSION OR CONVULSIONS OR IMPAIRED GAG REFLEX, IPECAC EMESIS CAN BE DONE. WHEN VOMITING BEGINS, KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION. AFTER VOMITING STOPS, GIVE 30-60 MILLILITERS OF FLEET'S PHOSPHO-SODA DILUTED 1:4 IN WATER. MAINTAIN AIRWAY. BLOOD PRESSURE AND RESPIRATION. (DREISSACH, HANDBOOK OF POISONING, 11TH ED.) TREATMENT MUST BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL. GET MEDICAL ATTENTION.

ANTIDOTE:

NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

-----  
REACTIVITY

REACTIVITY:

STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:

HEXANE:

CALCIUM HYPOCHLORITE: FIRE AND EXPLOSION HAZARD.  
CHLORINE (LIQUID): FIRE AND EXPLOSION HAZARD.  
DINITROGEN TETRAOXIDE: POSSIBLE EXPLOSION HAZARD.  
OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.  
OXYGEN (CONCENTRATED): FIRE AND EXPLOSION HAZARD.  
PLASTICS, RUBBER, AND COATINGS: MAY BE ATTACKED.  
SODIUM HYPOCHLORITE: FIRE AND EXPLOSION HAZARD.

DECOMPOSITION:

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:

HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

-----  
STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

=====

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1981. RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

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DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262, EPA HAZARDOUS WASTE NUMBER D001, 100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

\*\*\*\*\*  
CONDITIONS TO AVOID

AVOID CONTACT WITH HEAT, SPARKS, FLAMES, OR OTHER SOURCES OF IGNITION. VAPORS MAY BE EXPLOSIVE. AVOID OVERHEATING OF CONTAINERS; CONTAINERS MAY VIOLENTLY RUPTURE IN HEAT OF FIRE. AVOID CONTAMINATION OF WATER SOURCES.

\*\*\*\*\*  
SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:  
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND RESTRICT ENTRY.

-----  
PROTECTIVE EQUIPMENT

VENTILATION:  
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:  
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION. THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE. MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:  
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:  
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:  
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.  
CREATION DATE: 05/23/85 REVISION DATE: 03/28/90

-ADDITIONAL INFORMATION-

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(\*\*HYDROCHLORIC ACID, CONCENTRATED (36-37)  
\*\*HYDROCHLORIC ACID, CONCENTRATED (36-37)  
\*\*HYDROCHLORIC ACID, CONCENTRATED (36-37)

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC  
CHEMICAL DIVISION  
1 REAGENT LANE  
FAIR LAWN NJ 07410  
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100  
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SUBSTANCE IDENTIFICATION

SUBSTANCE: \*\*HYDROCHLORIC ACID, CONCENTRATED (36-37X)\*\*  
CAS-NUMBER 7647-01-0

TRADE NAMES/SYNONYMS:

CHLORHYDRIC ACID; HYDROCHLORIDE; MURIATIC ACID; SPIRITS OF SALT;  
HYDROCHLORIC ACID, CONCENTRATED; HYDROGEN CHLORIDE, 23 EB; A142; A144; A508;  
A466; A4662; UN 1789; A481;

CHEMICAL FAMILY:  
Inorganic acid

MOLECULAR FORMULA: H-CL

MOLECULAR WEIGHT: 36.46

Hydrochloric Acid  
Trace metal Grade

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0  
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: HYDROGEN CHLORIDE  
CAS# 7647-01-0

PERCENT: 35.0-38.0

COMPONENT: WATER

PERCENT: 62.0-65.0

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

5 ppm (7.6 mg/m3) OSHA ceiling

5 ppm (7.6 mg/m3) ACGIH ceiling

5 ppm (7.6 mg/m3) NIOSH recommended ceiling

5 ppm (7.6 mg/m3) DFG MAK TWA;

10 ppm (15.2 mg/m3) DFG MAK 5 minute peak, momentary value, 8 times/shift

Measurement method: Silica gel tube; sodium bicarbonate/sodium carbonate;  
... ..

5000 pound SARA Section 304 Reportable Quantity (gas)  
 5000 pounds CERCLA Section 103 Reportable Quantity (liquid)  
 5000 pounds OSHA Process Safety Management Threshold Quantity (gas)  
 Subject to SARA Section 313 Annual Toxic Chemical Release Reporting

PHYSICAL DATA

DESCRIPTION: Colorless or slightly yellow fuming liquid with a pungent

odor. BOILING POINT: 384 F (196 C) SPECIFIC GRAVITY: 1.2

VAPOR PRESSURE: not available PH: 1.1 (0.1 M)

SOLUBILITY IN WATER: soluble VAPOR DENSITY: 1.3

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:

Negligible fire hazard when exposed to heat or flame.

FIREFIGHTING MEDIA:

Dry chemical, carbon dioxide, water spray or regular foam  
 (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam  
 (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:

Move container from fire area if you can do it without risk. Apply cooling  
 water to sides of containers that are exposed to flames until well after fire  
 is out. Stay away from ends of tanks (1993 Emergency Response Guidebook,  
 RSPA P 5800.6, Guide Page 60).

Extinguish using agents suitable for type of fire. Use flooding amounts of  
 water as fog. Cool containers with flooding amounts of water, apply from as  
 far a distance as possible. Avoid breathing corrosive vapors, keep upwind.

TRANSPORTATION DATA

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:  
 Hydrochloric acid, solution-UN 1789

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:  
 8 - Corrosive material

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:  
 PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101  
 AND PART E:  
 Corrosive

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EXCEPTIONS: 49 CFR 173.154  
NON-BULK PACKAGING: 49 CFR 173.202  
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:  
PASSENGER AIRCRAFT OR RAILCAR: 1 L  
CARGO AIRCRAFT ONLY: 30 L

# TOXICITY

## HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

### IRRITATION DATA:

ANHYDROUS: 100 mg/30 seconds rinsed eye-rabbit mild.

HYDROCHLORIC ACID: 5 mg/30 seconds rinsed eye-rabbit mild.

### TOXICITY DATA:

HYDROGEN CHLORIDE (ANHYDROUS GAS): 4701 ppm/30 minutes inhalation-rat LC50;  
2644 ppm/30 minutes inhalation-mouse LC50.

MONOHYDRATE: No data available.

DIHYDRATE: No data available.

TRIHYDRATE: No data available.

HEXAHYDRATE: No data available.

HYDROGEN CHLORIDE (AEROSOL): 5666 ppm/30 minutes inhalation-rat LC50; 2142  
ppm/30 minutes inhalation-mouse LC50.

HYDROCHLORIC ACID: 1300 ppm/30 minutes inhalation-human LCLo; 3000 ppm/5  
minutes inhalation-human LCLo; 3124 ppm/1 hour inhalation-rat LC50;

1108 ppm/1 hour inhalation-mouse LC50; 4413 ppm/30 minutes

inhalation-rabbit LCLo; 4413 ppm/30 minutes inhalation-guinea pig LCLo;

685 ug/m<sup>3</sup>/24 hours/84 days continuous inhalation-rat LCLo; 900 mg/kg

oral-rabbit LD50; 1449 mg/kg intraperitoneal-mouse LD50; 81 mg/kg

unreported-man LCLo; mutagenic data (NIEHS); reproductive effects data

(RTECS).

CARCINOGEN STATUS: Human Inadequate Evidence, Animal Inadequate Evidence

(IARC Group-3).

LOCAL EFFECTS: Corrosive- inhalation, skin, eye and ingestion.

ACUTE TOXICITY LEVEL: Moderately toxic by inhalation and ingestion.

TARGET EFFECTS: No data available.

## HEALTH EFFECTS AND FIRST AID

### INHALATION:

#### HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

CORROSIVE. 100 ppm Immediately Dangerous to Life or Health.

ACUTE EXPOSURE- Inhalation of gas or fumes at levels of 5-35 ppm may

cause irritation and burning of the throat, coughing and choking;

50-100 ppm may be barely tolerable for 1 hour. High levels may cause

inflammation and occasionally ulceration of the nose, throat or larynx,

bronchitis, pneumonia, palpitations and headache. Higher concentrations

may cause necrosis of the tracheal and bronchial epithelium, nasoseptal

perforation, atelectasis, emphysema, damage to pulmonary blood vessels

and lesions of the liver and other organs. Death may be due to laryngeal

spasm, bronchopneumonia or pulmonary edema. 1300-2000 ppm may be

dangerous, even on brief exposures. Reproductive effects have been

reported in animals.

CHRONIC EXPOSURE- Repeated or prolonged exposure may cause erosion and

discoloration of exposed teeth, chronic bronchitis and gastritis.

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**FIRST AID-** Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

**SKIN CONTACT:**  
**HYDROGEN CHLORIDE (HYDROCHLORIC ACID):**  
**CORROSIVE.**

**ACUTE EXPOSURE-** Contact may cause severe irritation, inflammation, ulceration, necrosis and chemical burns. Shock symptoms may develop including rapid pulse, sweating and collapse. Photosensitization reactions may occur in persons previously exposed. Contact with a compressed gas may cause frostbite.

**CHRONIC EXPOSURE-** Repeated or prolonged contact with vapors or dilute solutions may cause dermatitis. Photosensitization may occur.

**FIRST AID-** Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). If burns occur, proceed with the following: Cover affected area securely with sterile, dry, loose-fitting dressing. Treat symptomatically and supportively. Get medical attention immediately.

**EYE CONTACT:**  
**HYDROGEN CHLORIDE (HYDROCHLORIC ACID):**  
**CORROSIVE.**

**ACUTE EXPOSURE-** Contact may cause severe irritation, conjunctivitis, corneal necrosis and burns with impairment or permanent loss of vision. A drop of hydrochloric acid splashed in the eye and immediately washed out has produced a white coagulation of the corneal and conjunctival epithelium. Animals exposed to vapor concentrations of 1350 ppm for one and a half hours showed clouding of the cornea and 300 ppm for 6 hours showed slight erosion of the corneal epithelium. Contact with a compressed gas may cause frostbite.

**CHRONIC EXPOSURE-** Animals exposed to vapor at 100 ppm for 6 hours daily for 50 days showed only slight unrest and irritation of the eyes, but no ocular injury. Effects are dependent upon concentration and duration of exposure. Conjunctivitis or effects similar to those for acute exposure may occur.

**FIRST AID-** Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. Get medical attention immediately.

**INGESTION:**  
**HYDROGEN CHLORIDE (HYDROCHLORIC ACID):**  
**CORROSIVE.**

**ACUTE EXPOSURE-** Ingestion of the acid may cause burns of the mouth, throat, esophagus and stomach with consequent pain, uneasiness, nausea, vomiting, diarrhea, chills, shock and intense thirst. Nausea, fever and perforation of the intestinal tract, and circulatory collapse may occur. Death may be due to esophageal or gastric necrosis.

**CHRONIC EXPOSURE-** No data available.

or milk. Repeat if vomiting occurs. Ingested corrosive should be diluted approximately 100 times to render it harmless to tissues. (Dreisbach & Robertson; Handbook of Poisoning; 12th Ed.). Do not give anything by mouth to a person who is unconscious or otherwise unable to swallow. If vomiting occurs, keep head lower than hips to help prevent aspiration. Maintain airway and respiration. Treat symptomatically and supportively. Get medical attention immediately.

**ANTIDOTE:**

No specific antidote. Treat symptomatically and supportively.

**REACTIVITY****REACTIVITY:**

Reacts exothermically with water or steam to produce toxic and corrosive fumes.

**INCOMPATIBILITIES:**

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

ACETIC ANHYDRIDE: Violent reaction.

ALCOHOLIC HYDROGEN CYANIDE: Explosive reaction.

ALUMINUM: Explosion.

ALUMINUM-TITANIUM ALLOYS: Ignites or incandesces when heated.

2-AMINOETHANOL: Violent reaction.

AMMONIUM HYDROXIDE: Violent reaction.

BASES: Violent reaction.

BRASS: Corrodes.

BRONZE: Corrodes.

CALCIUM CARBIDE: Reacts with incandescence.

CALCIUM HYPOCHLORITE: Ignition.

CESIUM ACETYLIDE: Ignites on contact.

CHLORINE + DINITROANILINES: Vigorous reaction with release of flammable hydrogen gas fumes.

CHLOROSULFONIC ACID: Violent reaction.

1,1-DIFLUOROETHYLENE: Extremely exothermic decomposition reaction.

DDMCIL 100: Decomposes.

ETHYLENE DIAMINE: Violent reaction.

ETHYLENE IMINE: Violent reaction.

FLUORINE: Ignites on contact.

HEXALITHIUM DISILICIDE: Incandesces.

IRON: Corrodes with evolution of flammable hydrogen gas.

MAGNESIUM BORIDE: Produces a spontaneously flammable gas.

MERCURIC SULFATE: Violent reaction at 125 C.

METAL ACETYLIDES: Violent reaction.

METALS: Severe corrosion with evolution of flammable hydrogen gas.

OLEUM: Violent reaction.

OXIDIZERS (STRONG): Violent reaction.

OXYGEN + PLATINUM: Ignites on contact.

PERCHLORIC ACID: Violent reaction.

PLASTICS, RUBBER, COATINGS: Attacks.

POTASSIUM PERMANGANATE: Explosion hazard.

BETA-PROPIOLACTONE: Violent reaction.

PROPYLENE OXIDE: Violent reaction.

RUBIDIUM ACETYLIDE: Ignites on contact.

SILICA (GEL): Incompatible.

SODIUM: Vigorous or explosive reaction.

SULFURIC ACID: Explosive reaction with release of toxic hydrogen chloride

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gas.  
TETRASELENIUM TETRAINITRIDE: Explodes on contact.  
VINYL ACETATE: Violent reaction.

DECOMPOSITION:  
Thermal decomposition may release corrosive hydrogen chloride.

POLYMERIZATION:  
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

#### STORAGE AND DISPOSAL

Observe all federal, state and local regulations when storing or disposing of this substance.

#### \*\*Storage\*\*

Protect against physical damage. Store in cool, well-ventilated place, separated from all oxidizing materials (NFPA 49, Hazardous Chemicals Data, 1975).

Store away from incompatible substances.

#### \*\*Disposal\*\*

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262, EPA Hazardous Waste Number 0002.  
100 pound CERCLA Section 103 Reportable Quantity.

\*\*\*\*\*  
CONDITIONS TO AVOID  
\*\*\*\*\*

May burn but does not ignite readily. Flammable, poisonous gases may accumulate in tanks and happen cars. May ignite combustibles (wood, paper, oil, etc.).

\*\*\*\*\*  
SPILL AND LEAK PROCEDURES  
\*\*\*\*\*

#### SOIL SPILL:

Dig holding area such as lagoon, pond or pit for containment.

Dike flow of spilled material using soil or sandbags or foamed barriers such as polyurethane or concrete.

Use cement powder or fly ash to absorb liquid mass.

Neutralize spill with slaked lime, sodium bicarbonate or crushed limestone.

#### AIR SPILL:

Knock down vapors with water spray. Keep upwind.

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contained properly for later disposal.

#### WATER SPILL:

Neutralize with agricultural lime, slaked lime, crushed limestone, or sodium bicarbonate.

#### OCCUPATIONAL SPILL:

Do not touch spilled material. Stop leak if you can do it without risk. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For small dry spills, with clean shovel place material into clean, dry container and cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

Reportable Quantity (RQ): 5000 pounds  
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

#### PROTECTIVE EQUIPMENT

#### VENTILATION:

Provide local exhaust ventilation system to meet published exposure limits.

#### RESPIRATOR:

The following respirators are recommended based on information found in the physical data, toxicity and health effects sections. They are ranked in order from minimum to maximum respiratory protection.  
The specific respirator selected must be based on contamination levels found in the work place, must be based on the specific operation, must not exceed the working limits of the respirator and must be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

#### HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

- 50 ppm- Any supplied-air respirator.  
Any self-contained breathing apparatus.  
Any chemical cartridge respirator with cartridge(s) providing protection against hydrochloric acid.
- 100 ppm- Any supplied-air respirator operated in a continuous flow mode.  
Any supplied-air respirator with a full facepiece.  
Any self-contained breathing apparatus with a full facepiece.  
Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against hydrochloric acid.  
Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against hydrochloric acid.  
Any powered, air-purifying respirator with cartridge(s) providing protection against hydrochloric acid.  
Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister.

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Any appropriate escape-type self-contained breathing apparatus.

**FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:**

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

**CLOTHING:**

Employee must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

**GLOVES:**

Employee must wear appropriate protective gloves to prevent contact with this substance.

**EYE PROTECTION:**

Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

**Emergency wash facilities:**

Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

AUTHORIZED - FISHER SCIENTIFIC, INC.

CREATION DATE: 04/30/85

REVISION DATE: 12/02/94

**-ADDITIONAL INFORMATION-**

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P. O. BOX 3047  
HOUSTON, TX 77253

## MATERIAL SAFETY DATA SHEET

## I - GENERAL INFORMATION

PRODUCT NAME HYDROGEN SULFIDE

EMERGENCY TELEPHONE NO. 713-368-0333

MANUFACTURERS NAME AVAILABLE FROM VARIOUS SOURCES

TRADE NAME/SYNONYMS HYDROGEN SULFIDE, DIHYDROGEN SULFIDE

CHEMICAL NAME AND SYNONYMS

HYDROGEN SULFIDE

REVISION DATE: 12/01/89

PRODUCT ID. UN 1053 FORMULA H<sub>2</sub>S

CHEMICAL FAMILY N/A

CAS NUMBER 7783-06-4

## II - HAZARDOUS INGREDIENTS

HAZARDOUS MIXTURES OF LIQUIDS AND GASES

O/O

TLV

HYDROGEN SULFIDE

100

## III - PHYSICAL DATA

BOILING POINT -60.3 C (-76.6 F)

SPECIFIC GRAVITY N/A

VAPOR PRESSURE 1737 KPA (GAUGE); 252 PSIA @ 21.1 C

PERCENT VOLATILE BY VOLUME (O/O) N/A

DENSITY (AIR = 1): 1.188 @ 1 ATM, 25 C

EVAPORATION RATE N/A

SOLUBILITY IN WATER 2.257 CM<sup>3</sup>/1 CM<sup>3</sup> @ 1 ATM, 25 C

MATERIAL AT NORMAL CONDITION GAS

MOL WT.: 34.076

EXPANSION RATIO (LIQUID TO GAS) N/A

FREEZING POINT: -85.5 C (-121.9 F)

APPEARANCE AND ODOR

\*SEE NOTES\*

\*\*\*\*\* SECTION NOTES \*\*\*\*\*

AT ROOM TEMPERATURE AND ATMOSPHERIC PRESSURE, HYDROGEN SULFIDE IS A COLORLESS, FLAMMABLE, TOXIC GAS HAVING AN OFFENSIVE ODOR DESCRIBED AS THAT OF ROTTEN EGGS. IT IS SHIPPED AS A LIQUEFIED GAS UNDER ITS OWN VAPOR PRESSURE.

## IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT N/A

FLASH POINT (METHOD USED)

FLAMMABILITY LIMITS IN AIR (O/O BY VOL) LOWER 4.3

UPPER 46.0

EXTINGUISHING MEDIA

N/A

AUTOIGNITION TEMPERATURE: 260 C (500 F)

SPECIAL FIRE FIGHTING PROCEDURES

THE ONLY SAFE WAY TO EXTINGUISH A HYDROGEN SULFIDE FIRE IS TO STOP THE FLOW OF GAS. IF THE FLOW CANNOT BE STOPPED, LET THE FIRE BURN ITSELF OUT WHILE COOLING THE CYLINDER AND THE SURROUNDINGS USING A WATER SPRAY.

FIREFIGHTERS MUST WEAR SPECIAL PERSONAL PROTECTIVE SUITS FOR FIRE/CHEMICALS AND POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS. FIREFIGHTERS' TURNOUT GEAR IS INADEQUATE.

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M A T E R I A L S A F E T Y D A T A S H E E T  
PRODUCT NAME HYDROGEN SULFIDE

UNUSUAL FIRE AND EXPLOSION HAZARD

CYLINDERS THAT ARE EXPOSED TO FIRE MAY RUPTURE WITH VIOLENT FORCE. EXTINGUISH SURROUNDING FIRE AND KEEP CYLINDERS COOL USING A WATER SPRAY APPLIED FROM THE MAXIMUM POSSIBLE DISTANCE.

FLAMMABLE AND TOXIC GASES MAY SPREAD FROM A SPILL AFTER THE FIRE IS EXTINGUISHED AND BE SUBJECT TO REIGNITION.

V - H E A L T H H A Z A R D D A T A

THRESHOLD LIMIT VALUE

\*SEE NOTES\*

UNUSUAL CHRONIC TOXICITY

UNKNOWN

CARCINOGENICITY

N/A

ROUTES OF EXPOSURE

INHALATION, INGESTION, CONTACT

EFFECTS OF OVEREXPOSURE

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

PERSONS WITH IMPAIRED PULMONARY FUNCTION OR PRE-EXISTING EYE PROBLEMS MAY BE AT INCREASED RISK FROM EXPOSURE.

ACUTE EFFECTS OF OVEREXPOSURE:

EXPOSURE TO HYDROGEN SULFIDE MAY CAUSE IRRITATION OF THE EYES AND RESPIRATORY TRACT AS WELL AS HEADACHE, DIZZINESS, AND UPSET STOMACH. EXPOSURE TO HIGH CONCENTRATIONS MAY BE INSTANTLY FATAL.

LIQUID HYDROGEN IS CORROSIVE TO THE SKIN AND MAY CAUSE FROSTBITE.

CHRONIC EFFECTS OF OVEREXPOSURE:

REPEATED EXPOSURES TO LOW CONCENTRATIONS IS REPORTED TO CAUSE CONJUNCTIVITIS, PHOTOPHOBIA, CORNEAL BULLEA, TEARING, PAIN, AND BLURRED VISION.

NOTE:

THE FOUL ODOR CANNOT BE DEPENDED ON TO GIVE A WARNING OF EXPOSURE TO HIGH OR DANGEROUS CONCENTRATIONS BECAUSE OF OLFACTORY FATIGUE.

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: MOVE VICTIM TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

CONTACT: IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.

\*\*\*\*\* SECTION NOTES \*\*\*\*\*

OSHA CEILING CONCENTRATION: 20 PPM\*

ACGIH TWA: 10 PPM (14 MG/M3)

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MATERIAL SAFETY DATA SHEET  
PRODUCT NAME HYDROGEN SULFIDE

ACGIH STEL: 15 PPM (21 MG/M3)

\*OSHA ALLOWS A MAXIMUM PEAK OF 50 PPM ONCE PER 8 HOUR  
SHIFT FOR A MAXIMUM DURATION OF 10 MINUTES ONLY IF NO  
OTHER MEASURABLE EXPOSURE OCCURS.

VI - REACTIVITY DATA

STABILITY STABLE

CONDITIONS TO AVOID

N/A

INCOMPATIBILITY (MATERIALS TO AVOID)

OXIDIZING MATERIALS, RUBBER, LEAD, SILVER, ALKALI  
METALS AND MERCURY.

HAZARDOUS DECOMPOSITION PRODUCTS

WHEN HEATED TO DECOMPOSITION, HIGHLY TOXIC SULFUR OXIDES  
ARE EMITTED.

HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID

N/A

VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

THE FIRST STEP TO TAKE IN THE EVENT OF A LEAK IS TO EVACUATE  
THE AREA. PERSONNEL EQUIPPED WITH SPECIAL PERSONAL PROTEC-  
TIVE SUITS FOR FIRE/CHEMICALS AND POSITIVE PRESSURE SELF-  
CONTAINED BREATHING APPARATUS CAN RE-ENTER THE AREA AND  
ATTEMPT TO STOP THE LEAK IF THERE ARE NO SOURCES OF IGNI-  
TION PRESENT.

WASTE DISPOSAL METHOD

N/A

VIII - SPECIAL PROTECTIVE INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)

POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS SHOULD  
BE WORN IF IT IS SUSPECTED THAT HYDROGEN SULFIDE IS IN THE  
AIR.

VENTILATION

N/A

PROTECTIVE GLOVES

\*SEE NOTES\*

EYE PROTECTION



M A T E R I A L S A F E T Y D A T A S H E E T  
PRODUCT NAME HYDROGEN SULFIDE

SAFETY GLASSES SHOULD BE WORN  
OTHER PROTECTIVE EQUIPMENT

N/A

\*\*\*\*\* SECTION NOTES \*\*\*\*\*

AS A MINIMUM, IMPERVIOUS GLOVES SHOULD BE WORN WHEN  
HANDLING LINES AND EQUIPMENT CONTAINING HYDROGEN SULFIDE.

I X - S P E C I A L P R E C A U T I O N S

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

CYLINDERS SHOULD BE STORED AND USED IN DRY, WELL VENTILATED  
AREAS AWAY FROM SOURCES OF HEAT OR IGNITION. DO NOT STORE  
WITH OXIDIZERS.

D.O.T. LABELING

FLAMMABLE GAS

VALVE CONNECTION

N/A

OTHER PRECAUTIONS

BEFORE USING THE GAS:

1. SECURE THE CONTAINER TO PREVENT IT FROM FALLING OR BEING  
KNOCKED OVER.
2. INSTALL CHECK VALVES OR TRAPS TO PREVENT SUCKBACK TO THE  
CONTAINER.
3. LEAK CHECK THE LINES AND EQUIPMENT.
4. GROUND ALL LINES AND EQUIPMENT.
5. HAVE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPA-  
RATUS, EYEWASH STATIONS AND SAFETY SHOWERS READILY  
AVAILABLE.
6. HAVE AN EMERGENCY PLAN COVERING STEPS TO BE TAKEN IN THE  
EVENT OF AN ACCIDENTAL RELEASE.

THIS PRODUCT SAFETY DATA SHEET IS OFFERED SOLELY FOR YOUR INFORMATION,  
CONSIDERATION, INVESTIGATION, IN COMPLIANCE WITH HAZARD COMMUNICATION STANDARD  
29 CFR 1900.1200. AIR LIQUIDE AMERICA CORP. PROVIDES NO WARRANTIES, EITHER  
EXPRESS OR IMPLIED.

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## Material Safety Data Sheet

<b>LIQUID AIR CORPORATION</b> ALPHAGAZ DIVISION One California Plaza, Suite 350 2121 N. California Blvd. Walnut Creek, California 94596	<b>PRODUCT NAME</b> Isobutylene	<b>CAS NUMBER</b> 115-11-7
	<b>TELEPHONE (415) 977-6500</b> <b>EMERGENCY RESPONSE INFORMATION ON PAGE 2</b>	
	<b>TRADE NAME AND SYNONYMS</b> Isobutylene	
<b>ISSUE DATE</b> OCTOBER 1, 1985 <b>AND REVISIONS</b> CORPORATE SAFETY DEPT.	<b>CHEMICAL NAME AND SYNONYMS</b> Isobutene, Isobutylene, 2-Methylpropene	
	<b>FORMULA</b> (iso) C <sub>4</sub> H <sub>8</sub> <b>MOLECULAR WEIGHT</b> 56.03	<b>CHEMICAL FAMILY</b> Monolefin

See last page.

### HEALTH HAZARD DATA

**TIME WEIGHTED AVERAGE EXPOSURE LIMIT** Isobutylene is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg. (ACGIH, 1984-85)

#### SYMPTOMS OF EXPOSURE

**Inhalation:** Moderate concentrations so as to exclude an adequate supply of oxygen to the lungs causes dizziness, drowsiness and eventual unconsciousness. It also has a very mild anesthetic effect which might cause lack of co-ordination or lessened mental alertness.

**Skin and Eye Contact:** It is mildly irritating to mucous membranes. Due to its rapid rate of evaporation, it can cause tissue freezing or frostbite on dermal contact.

#### TOXICOLOGICAL PROPERTIES

It has a very mild anesthetic effect; however, the major property is the exclusion of an adequate supply of oxygen to the lungs.

Frostbite effects are a change in color of the skin to gray or white possibly followed by blistering.

Listed as Carcinogen  
or Potential Carcinogen

National Toxicology  
Program Yes ☐  
No ☒

I.A.R.C.  
Monographs Yes ☐  
No ☒

OSHA Yes ☐  
No ☒

#### RECOMMENDED FIRST AID TREATMENT

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO ISOBUTYLENE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND BE COGNIZANT OF EXTREME FIRE AND EXPLOSION HAZARD.

**Inhalation:** Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given mouth-to-mouth resuscitation and supplemental oxygen. Medical assistance should be sought immediately.

**Dermal Contact or Frostbite:** Remove contaminated clothing and flush affected areas  
(Continued on last page.)

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Liquid Air Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or consequences of its use. Since Liquid Air Corporation has no control over the use of this product, it assumes no liability for damage or loss of product resulting from proper (or improper) use or application of the product. Data Sheets may be changed from time to time. Be sure to consult the latest edition.

## HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

Isobutylene is flammable over a wide range in air.

## PHYSICAL DATA

BOILING POINT 19.18°F (-7.12°C)	LIQUID DENSITY AT BOILING POINT 39.09 lb/ft <sup>3</sup> (626.2 kg/m <sup>3</sup> )
VAPOR PRESSURE @ 70°F (21.1°C) = 38.43 psia (265 kPa)	GAS DENSITY AT 70°F 1 atm .148 lb/ft <sup>3</sup> (2.37 kg/m <sup>3</sup> )
SOLUBILITY IN WATER Insoluble	FREEZING POINT -220.63°F (-140.35°C)
APPEARANCE AND ODOR Colorless gas with an unpleasant odor similar to that which is emitted when burning anthracite coal. Specific gravity @70°F (Air = 1.0) is 1.98.	

## FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED) -105°F (-76°C) Closed cup	AUTO IGNITION TEMPERATURE 869°F (465°C)	FLAMMABLE LIMITS % BY VOLUME LEL: 1.8 UEL: 9.6
EXTINGUISHING MEDIA Water, carbon dioxide, dry chemical		ELECTRICAL CLASSIFICATION Class 1, Group not specified
SPECIAL FIRE FIGHTING PROCEDURES If possible, stop the flow of isobutylene. Use water spray to cool surrounding containers.		
UNUSUAL FIRE AND EXPLOSION HAZARDS Isobutylene is heavier than air and may travel a considerable distance to a source of ignition. Should flame be extinguished and flow of gas continue, increase ventilation to prevent flammable mixture formation in low areas pockets.		

## REACTIVITY DATA

STABILITY Unstable		CONDITIONS TO AVOID
Stable	X	
INCOMPATIBILITY (Materials to avoid) Oxidizers		
HAZARDOUS DECOMPOSITION PRODUCTS None		
HAZARDOUS POLYMERIZATION May Occur		CONDITIONS TO AVOID
Will Not Occur	X	

## SPILL OR LEAK PROCEDURES

## STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If leak is in container or container valve, contact the closest Liquid Air Corporation location.

## WASTE DISPOSAL METHOD

Do not attempt to dispose of waste or unused quantities. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place to Liquid Air Corporation for proper disposal. For emergency disposal, contact the closest Liquid Air Corporation location.

## EMERGENCY RESPONSE INFORMATION

IN CASE OF EMERGENCY INVOLVING THIS MATERIAL, CALL DAY OR NIGHT (800) 231-1366

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# SPECIAL PROTECTION INFORMATION

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RESPIRATORY PROTECTION (Specify type) Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.		
VENTILATION	LOCAL EXHAUST To prevent accumulation above the LEL.	SPECIAL
Hood with forced ventilation	MECHANICAL (Gen.) In accordance with electrical codes.	OTHER
PROTECTIVE GLOVES Plastic or rubber		
EYE PROTECTION Safety goggles or glasses		
OTHER PROTECTIVE EQUIPMENT Safety shoes, safety shower, eyewash "fountain"		

## SPECIAL PRECAUTIONS\*

### SPECIAL LABELING INFORMATION

DOT Shipping Name: Liquefied petroleum gas DOT Hazard Class: Flammable gas  
DOT Shipping Label: Flammable gas I.D. No.: UN 1075

### SPECIAL HANDLING RECOMMENDATIONS

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<250 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

For additional handling recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.

### SPECIAL STORAGE RECOMMENDATIONS

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130F (54C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use area. There should be no sources of ignition in the storage or use area.

For additional storage recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.

### SPECIAL PACKAGING RECOMMENDATIONS

Isobutylene is noncorrosive and may be used with any common structural material.

### OTHER RECOMMENDATIONS OR PRECAUTIONS

Earth-ground and bond all lines and equipment associated with the isobutylene system. Electrical equipment should be non-sparking or explosion proof. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).

\*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which may not be contained herein. The customer or user of this product should be familiar with these regulations

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LIQUID AIR CORPORATION  
ALPHAGAZ DIVISION

## ADDITIONAL DATA

## RECOMMENDED FIRST AID TREATMENT: (Continued)

with lukewarm water. DO NOT USE HOT WATER. A physician should see the patient promptly if the cryogenic "burn" has resulted in blistering of the dermal surface or deep tissue freezing.

## TIME WEIGHTED AVERAGE EXPOSURE LIMIT (Continued)

TWA (OSHA, 1985) for LPG (Liquefied Petroleum Gas) is 1,000 molar PPM.

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# MATERIAL SAFETY DATA SHEET

## LIQUI-NOX™

Manufactured by:  
ALCONOX, INC.  
9 EAST 40TH STREET  
NEW YORK, NY 10016

TELEPHONE NUMBER FOR EMERGENCY: CHEM-TEL 1-800-255-3924  
TELEPHONE NUMBER FOR INFORMATION: (212) 532-4040

### SECTION I: IDENTIFICATION

Product Name (As appears on Label):	LIQUI-NOX™
CAS Registry Number:	NOT APPLICABLE
Date Prepared:	JULY 29, 1993
Chemical Family:	ANIONIC LIQUID DETERGENT

### SECTION II: HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

THERE ARE NO HAZARDOUS INGREDIENTS IN LIQUI-NOX AS DEFINED BY THE OSHA STANDARD 29 CFR 1910 SUBPART Z, THE HAZARDOUS SUBSTANCE LIST.

### SECTION III: PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point:	214°F
Vapor Pressure (mm Hg):	NO DATA
Vapor Density (AIR =1):	NO DATA
Specific Gravity (Water=1):	1.075
Melting Point:	NOT APPLICABLE
Evaporation Rate (Butyl Acetate = 1):	SLOWER
Solubility in Water:	COMPLETELY SOLUBLE IN ALL PROPORTIONS
Appearance:	YELLOW LIQUID, NEARLY ODORLESS

### SECTION IV: FIRE AND EXPLOSION DATA

Flash Point:	NONE (CLEVELAND OPEN CUP)
Flammable Limits:	NOT APPLICABLE
Extinguishing Media:	LEL: NO DATA UEL: NO DATA WATER, DRY CHEMICALS, CO <sub>2</sub> , FOAM
Special Firefighting Procedures:	SELF-CONTAINED POSITIVE PRESSURE BREATHING APPARATUS AND PROTECTIVE CLOTHING SHOULD BE WORN FIGHTING FIRES INVOLVING CHEMICALS.
Unusual Fire and Explosion Hazards:	NONE.

### National Fire Protection Association 704 Labeling:

Degree of Hazard: 0 = insignificant, 1 = slight, 2 = moderate, 3 = high, 4 = extreme

RED (FIRE):	0
BLUE (HEALTH):	0
YELLOW (REACTIVITY):	0
WHITE (SPECIAL):	0

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Liqui-Max MSDS

Page 2 of 2

**SECTION V: REACTIVITY DATA**

Stability:  
 Conditions to Avoid:  
 Incompatibility (Materials to Avoid):  
 Hazardous Decomposition or Byproducts:

STABLE  
 NONE  
 OXIDIZING OR ALKALINE SOLUTIONS.  
 MAY RELEASE SO<sub>2</sub> ON BURNING.

**SECTION VI: HEALTH HAZARD DATA**

Routes of Entry: Inhalation?: NO  
 Health Hazards (Acute and Chronic):

Skin: YES Ingestion: YES  
 SKIN CONTACT MAY PROVE LOCALLY  
 IRRITATING, CAUSING DRYING AND/OR  
 CHAPPING. INGESTION MAY CAUSE  
 DISCOMFORT AND/OR DIARRHEA.

Carcinogenicity: NTP?: NO IARC Monographs?: NO  
 Signs and Symptoms of Exposure:

OSHA Regulated?: NO  
 PROLONGED SKIN CONTACT MAY CAUSE DRYING  
 AND/OR CHAPPING.

Medical Conditions Generally  
 Aggravated by Exposure:

NOT ESTABLISHED. UNNECESSARY EXPOSURE  
 TO THIS PRODUCT OR ANY INDUSTRIAL  
 CHEMICAL SHOULD BE AVOIDED.

**Emergency and First Aid**

Procedures: Eyes - IMMEDIATELY FLUSH WITH WATER FOR AT LEAST 15 MINUTES  
 Skin - FLUSH WITH PLENTY OF WATER  
 Ingestion - DRINK LARGE QUANTITIES OF WATER OR MILK.  
 SEE A PHYSICIAN FOR DISCOMFORT.

**SECTION VII: PRECAUTIONS FOR SAFE HANDLING AND USE**

Steps to be Taken if Material  
 is Released or Spilled:

MATERIAL FOAMS PROFUSELY. FOR SMALL  
 SPILLS RECOVER AS MUCH AS POSSIBLE WITH  
 ABSORBENT MATERIAL AND FLUSH REMAINDER  
 TO SEWER. MATERIAL IS BIODEGRADABLE.

Waste Disposal Method:

SMALL QUANTITIES MAY BE DISPOSED OF IN  
 SEWER. LARGE QUANTITIES SHOULD BE  
 DISPOSED OF IN ACCORDANCE WITH LOCAL  
 ORDINANCES FOR DETERGENT PRODUCTS

Precautions to be Taken in  
 Storing and Handling:

NO SPECIAL PRECAUTIONS IN STORING. USE  
 PROTECTIVE EQUIPMENT WHEN HANDLING  
 UNDILUTE MATERIAL.

Other Precautions:

NO SPECIAL REQUIREMENTS OTHER THAN GOOD  
 INDUSTRIAL HYGIENE AND SAFETY PRACTICES  
 EMPLOYED WITH ANY INDUSTRIAL CHEMICAL.

**VIII: CONTROL MEASURES**

Respiratory Protection (Specify Type): NOT REQUIRED

Ventilation: - Local Exhaust:

NORMAL

- Special:

NOT REQUIRED

- Mechanical:

NOT REQUIRED

- Other:

NOT REQUIRED

Protective Gloves:

IMPERVIOUS GLOVES ARE RECOMMENDED.

Eye protection:

GOGGLES AND/OR SPLASH SHIELDS ARE  
 RECOMMENDED.

Other Protective Clothing or  
 Equipment:

NOT REQUIRED

Work/Hygiene Practices:

NO SPECIAL PRACTICES REQUIRED.

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED  
 ON 03/28/95 12:21:30



# Scott Specialty Gases

22711

ROUTE 611 NORTH PLUMSTEADVILLE, PA 18949 (215) 766-8861

## REGIONAL PHONE NUMBERS

PA(215) 766-8861

MI(313) 589-2950

TX(713) 644-4820

CA(714) 857-2571

## MATERIAL SAFETY DATA SHEET

### SECTION I - MATERIAL IDENTIFICATION

CHEMICAL NAME: Methane in HC  
Free Air

SUPPLIER: Scott Specialty Gases

CHEMICAL FORMULA: CH<sub>4</sub>/AirADDRESS: Route 611 North  
Plumsteadville, PA 18949CHEMICAL FAMILY: Hydrocarbon Gas  
MixtureIN CASE OF EMERGENCY CONTACT YOUR  
REGIONAL PLANT MANAGER

OTHER DESIGNATION: None

### SECTION II - HAZARDOUS INGREDIENTS

COMPONENT	CONCENTRATION	TLV
Methane	1 ppm - 2.5%	---
Air	Balance	---

### SECTION III - PHYSICAL DATA

BOILING POINT (°F): N/A

SPECIFIC GRAVITY (H<sub>2</sub>O = 1): N/A

VAPOR PRESSURE: N/A

PERCENT, VOLATILE BY VOLUME (%): N/A

VAPOR DENSITY (AIR = 1) @20°C:  
0.989 - 1.00EVAPORATION RATE  
(\_\_\_\_\_ = 1): N/A

SOLUBILITY IN WATER v/v @17°C: 0.130

APPEARANCE AND ODOR: Colorless, odorless

### SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT AND METHOD	FLAMMABLE LIMITS	LEL	UEL
N/A	Nonflammable		

EXTINGUISHING MEDIA: Use what is appropriate for surrounding fire.

DISCLAIMER: The information in this Material Safety Data Sheet is offered without charge for use by technically qualified personnel at their discretion and risk. Scott Specialty Gases has made this sheet available with data which we believe is reliable, but the accuracy and completeness of the data is not guaranteed and no warranty is either expressed or implied. Since Scott Specialty Gases has no control over the use of this product determined herein, we assume no liability for loss or damages incurred from the proper or improper use of each product. This form is essentially similar to U.S. Department of Labor form OSHA 220.

FEB 7 '92 14:55

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SPECIAL FIRE FIGHTING PROCEDURES: Keep fire exposed cylinders cool with water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Compressed air may accelerate combustion.

---

SECTION V - REACTIVITY DATA

---

STABILITY: Stable.

INCOMPATIBILITY (MATERIALS TO AVOID): Avoid mixing methane with oxygen.

HAZARDOUS DECOMPOSITION PRODUCTS: None.

HAZARDOUS POLYMERIZATION: Will not occur.

---

SECTION VI - HEALTH HAZARD DATA

---

THRESHOLD LIMIT VALUE: See Section II.

EFFECTS OF OVER EXPOSURE: None.

EMERGENCY AND FIRST AID PROCEDURES: None.

---

SECTION VII - SPILL OR LEAK PROCEDURES

---

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Ventilate area. Remove leaking cylinder to exhaust hood or safe outdoors area. Shut off gas source if possible and remove sources of heat and ignition.

WASTE DISPOSAL METHOD: Allow gas to discharge at a slow rate. Return defective cylinder to supplier.

---

SECTION VIII - SPECIAL PROTECTION INFORMATION

---

RESPIRATORY PROTECTION (SPECIFY TYPE): Not required.

VENTILATION: Local and mechanical exhaust recommended.

OTHER PROTECTIVE EQUIPMENT: Safety glasses, safety shoes when handling cylinders.

---

SECTION IX - SPECIAL PRECAUTIONS

---

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in a well ventilated area away from oxidizers, sources of heat and ignition. No part of cylinder should be exposed to temperatures above 125°F.

OTHER PRECAUTIONS: Do not deface cylinders or labels. Move cylinders with an adequate hand truck. No smoking where methane is used. Nitrogen can be used to test methane lines for leaking before use.

methane, carbon dioxide, balance air calibration gas

# MATERIAL SAFETY DATA SHEET



LIQUID CARBONIC INDUSTRIES

810 JORIE BLVD. • OAK BROOK, IL 60521-2216 • 708 572-7500

METHANE, COMPRESSED

DOT: UN 1971  
HAZ.CL.: Division 2.1  
LABEL: Flammable Gas

September 1991

24 Hour Emergency Phone Numbers: (504) 673-8831; CHEMTREC (800) 424-9300

## SECTION I--PRODUCT IDENTIFICATION

CHEMICAL NAME: Methane  
COMMON NAME AND SYNONYMS: Methane, Marsh Gas, Methyl Hydride  
CHEMICAL FAMILY: Alkane  
FORMULA: CH<sub>4</sub>

## SECTION II--HAZARDOUS INGREDIENTS

MATERIAL	VOLUME %	CAS NO.	ACGIH TLV UNITS
Methane	99+	74-82-8	Simple Asphyxiant* OSHA 1989 TWA = None Listed

\* Oxygen levels should be maintained at greater than 18 molar % at normal atmospheric pressure (pO<sub>2</sub>>135 torr).

## SECTION III--PHYSICAL DATA

BOILING POINT (°F.):	-258.6	SPECIFIC GRAVITY (H <sub>2</sub> O=1):	N/A (Gas)
VAPOR PRESSURE:	@ 70°F *	% VOLATILE BY VOLUME:	N/A (Gas)
VAPOR DENSITY (AIR=1):	@ 70°F = 0.56	EVAPORATION RATE (BUTYL ACETATE=1):	N/A (Gas)
SOLUBILITY IN WATER:	Negligible		
APPEARANCE AND ODOR:	Colorless, odorless gas		
* Above the critical temperature			

## SECTION IV--FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):	N/A (Gas)	FLAMMABLE LIMITS:	LEL	UEL
EXTINGUISHING MEDIA:	Water, carbon dioxide, dry chemical		5.0	15.0
SPECIAL FIRE FIGHTING PROCEDURES: If possible, stop the flow of methane. Use water spray to cool surrounding containers.				

### UNUSUAL FIRE AND EXPLOSION HAZARDS:

Should flame be extinguished and flow of gas continue, increase ventilation to prevent flammable or explosive mixture formation.

## SECTION V--HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation?	Yes	Skin?	Yes	Ingestion?	No
Carcinogenicity:	NTP?	No	IARC Monographs?	No	OSHA?	No

### EFFECTS OF OVEREXPOSURE:

Inhalation: Effects of exposure to high concentrations so as to displace the oxygen in the air necessary for life are headache, dizziness, labored breathing and eventual unconsciousness.

Persons in ill health where such illness would be aggravated by exposure to methane should not be allowed to work with or handle this product.

### EMERGENCY AND FIRST AID PROCEDURES:

If Inhaled: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted respiration and supplemental oxygen. Further treatment should be symptomatic and supportive.

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#### SECTION VI--REACTIVITY DATA

---

STABILITY: UNSTABLE ( ) STABLE ( x )

CONDITIONS TO AVOID: Open flames or high temperatures

INCOMPATIBILITY (MATERIALS TO AVOID): Oxygen and strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION: MAY OCCUR ( ) WON'T OCCUR ( x )

CONDITIONS TO AVOID: N/A

---

#### SECTION VII--SPILL OR LEAK PROCEDURES

---

##### STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

Evacuate all personnel from affected area. Remove sources of heat and ignition. If possible (safely) stop leak or remove cylinder to a remote downwind location. Ventilation to remove released methane should be explosion proof.

##### WASTE DISPOSAL METHOD:

Burn in an appropriate flare or slowly release in a remote downwind area. Follow all applicable federal, state, and local regulations.

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#### SECTION VIII--SPECIAL PROTECTION INFORMATION

---

RESPIRATORY PROTECTION: Self-contained breathing apparatus available in event of release or "spill."

VENTILATION: LOCAL EXHAUST ( x )  
MECHANICAL (GENERAL) ( x ) To prevent accumulation above the LEL

PROTECTIVE GLOVES: Plastic or rubber

EYE PROTECTION: Safety goggles or glasses

OTHER PROTECTIVE EQUIPMENT: Safety shoes. Low oxygen alarm (less than 18%) where necessary.

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#### SECTION IX--SPECIAL PRECAUTIONS

---

##### PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

Cylinders should be stored separately from oxygen in a cool, dry, well ventilated area. No smoking, open flames, or sources of ignition should be permitted in the methane storage area. Protect cylinders from physical damage. Methane is a flammable high pressure gas and may form explosive mixtures with air. Do not allow the temperature where cylinders are stored to exceed 125°F.

##### OTHER PRECAUTIONS:

Electrically ground all lines and equipment associated with the methane system. All equipment should be non-sparking or explosion proof. Refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres." Use a check valve or trap in the methane cylinder discharge line to prevent hazardous back flow. Cylinders or containers may not be recharged except by or with the consent of Liquid Carbonic.

Reporting under SARA, Title III, Section 313 not required.

NEPA 704 NO. for methane = 1 4 0

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# MATERIAL SAFETY DATA SHEET



## LIQUID CARBONIC INDUSTRIES

810 JORIE BLVD. - OAK BROOK, IL 60521-2216 - 708 572-7500

## CARBON DIOXIDE

DOT: UN 1013  
HAZ.CL.: Division 2.2  
LABEL: Nonflammable Gas  
June 1991

24 Hour Emergency Phone Numbers: (504) 673-8831; CHEMTREC (800) 424-9300

### SECTION I--PRODUCT IDENTIFICATION

CHEMICAL NAME: Carbon Dioxide  
COMMON NAME AND SYNONYMS: Gaseous Carbon Dioxide, Carbon Dioxide,  
Carbon Anhydride, Carbonic Acid Gas FORMULA: CO<sub>2</sub>  
CHEMICAL FAMILY: Carbonate

### SECTION II--HAZARDOUS INGREDIENTS

MATERIAL	VOLUME %	CAS NO.	1992-1993 ACGIH TLV UNITS
Carbon Dioxide	99.5+	124-38-9	TWA = 5,000 Molar PPM STEL = 30,000 Molar PPM OSHA 1991 TWA = 10,000 Molar PPM OSHA 1991 STEL = 30,000 Molar PPM

### SECTION III--PHYSICAL DATA

BOILING POINT (°F.): (Sublimes) -109.3 SPECIFIC GRAVITY (H<sub>2</sub>O=1): \*  
VAPOR PRESSURE: @ 68°F = 831 psig % VOLATILE BY VOLUME: 100%  
VAPOR DENSITY (AIR=1): @ 68°F = 1.53 EVAPORATION RATE (BUTYL ACETATE=1): N/A  
SOLUBILITY IN WATER: @ 68°F = 87.8% by Volume  
APPEARANCE AND ODOR: Colorless gas, slight pungent odor  
\* @ 1 ATM Solid @ -11°F = 1.56

### SECTION IV--FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED): N/A FLAMMABLE LIMITS: LEL UEL  
EXTINGUISHING MEDIA: None  
Nonflammable gas - carbon dioxide is an extinguishing agent

### SPECIAL FIRE FIGHTING PROCEDURES:

If cylinders are exposed to a fire, safely relocate or keep cool with water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

### SECTION V--HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes Skin? No Ingestion? No  
Carcinogenicity: NTP? No IARC Monographs? No OSHA? No

### EFFECTS OF OVEREXPOSURE:

Inhalation: At 2 to 3% concentration symptoms of simple asphyxia occur; 3 to 5% causes increased respiration and headache; up to 15% causes headache, nausea, vomiting and unconsciousness. Higher concentrations cause rapid circulatory insufficiency leading to a coma and death. CO<sub>2</sub> is the most powerful cerebral vasodilator known. Persons in ill health where such illness would be aggravated by exposure to gaseous carbon dioxide should not be allowed to work with or handle this product.

### EMERGENCY AND FIRST AID PROCEDURE:

If Inhaled: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. If unconscious, provide assisted respiration and supplemental oxygen. Further treatment should be symptomatic and supportive. Self-contained breathing apparatus should be available for rescue personnel.

(Continued on Supplemental Sheet)

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#### SECTION VI--REACTIVITY DATA

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STABILITY: UNSTABLE ( ) STABLE ( x )

CONDITIONS TO AVOID: N/A

INCOMPATIBILITY (MATERIALS TO AVOID): If moisture is present, it may form carbonic acid.

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION: MAY OCCUR ( ) WON'T OCCUR ( x )

CONDITIONS TO AVOID: N/A

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#### SECTION VII--SPILL OR LEAK PROCEDURES

---

##### STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

Evacuate all personnel from affected area. Ventilate area of leak with supplemental fans. Carbon dioxide is heavier than air and will collect in low areas. Use self-contained breathing apparatus to enter leaking cylinder area.

##### WASTE DISPOSAL METHOD:

If possible, remove cylinder to remote area (downwind) and allow to slowly vent to atmosphere.

---

#### SECTION VIII--SPECIAL PROTECTION INFORMATION

---

RESPIRATORY PROTECTION: Positive pressure air line with mask or self-contained breathing apparatus.

VENTILATION: LOCAL EXHAUST ( x ) Provide adequate ventilation to prevent concentration over the allowable TWA or STEL  
MECHANICAL (GENERAL) ( x )

PROTECTIVE GLOVES: Cotton or leather

EYE PROTECTION: Safety goggles or glasses

##### OTHER PROTECTIVE EQUIPMENT:

Safety shoes. Use low oxygen alarm (less than 18%) where necessary. Use appropriate protective equipment when welding.

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#### SECTION IX--SPECIAL PRECAUTIONS

---

##### PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

Use only DOT or ASME coded containers. Protect cylinders from physical damage. Store in well-ventilated, cool, and dry areas. Follow normal compressed gas storage recommendations. Do not store cylinders at high temperatures or over 120°F. Store carbon dioxide cylinders with the cap on tight and valve end up. Avoid low storage areas and corrosive chemicals.

##### OTHER PRECAUTIONS:

Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. See Compressed Gas Bulletin SB-2, "Oxygen Deficient Atmospheres," CGA Pamphlets P-1, "Safe Handling of Compressed Gases in Containers;" G-6, "Carbon Dioxide;" G-6.1, "Standard for Low Pressure CO<sub>2</sub> Systems at Consumer Sites;" G-6.3, "Carbon Dioxide Cylinder Filling and Handling Procedures for Beverage Plants, NSDA TD01."

(Continued on Supplemental Sheet)

SUPPLEMENTAL SHEET - CARBON DIOXIDE MATERIAL SAFETY DATA SHEET

SECTION V--HEALTH HAZARD DATA

EMERGENCY AND FIRST AID PROCEDURES: (Continued)

CAUTION: Welding or brazing may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z-49.1 "Safety in Welding and Cutting" published by the American Welding Society and OSHA safety regulations under 29 CFR 1910.252 "Welding, Cutting and Brazing." Also see ACGIH TLVs 1990-1991 Appendix B, Section B2, "Welding Fumes." ARC RAYS can injure eyes and burn skin.

SECTION IX--SPECIAL PRECAUTIONS

OTHER PRECAUTIONS: (Continued)

Consult manufacturer's MSDS sheet on welding consumables and related products for reactivity and health hazard data, and for further information regarding welding fumes.

Reporting under SARA, Title III, Section 313 not required.

NFPA 704 No. for carbon dioxide = 1 0 0

# MATERIAL SAFETY DATA SHEET



**LIQUID CARBONIC INDUSTRIES**

310 JORIE BLVD. • OAK BROOK, IL 60521-2215 • 708 572-7500

OXYGEN, COMPRESSED

DOT: UN 1072  
HAZ.CL.: Division 2.2  
LABELS: Nonflammable Gas,  
Oxidizer

October 1991

24 Hour Emergency Phone Numbers: (504) 673-8831; CHEMTREC (800) 424-9300

## SECTION I--PRODUCT IDENTIFICATION

CHEMICAL NAME: Oxygen  
COMMON NAME AND SYNONYMS: Oxygen, Compressed (D.O.T.); Gaseous Oxygen, GOX;  
Oxygen Gas  
CHEMICAL FAMILY: Oxidizer FORMULA: O<sub>2</sub>

## SECTION II--HAZARDOUS INGREDIENTS

MATERIAL	VOLUME %	CAS NO.	1991-1992 ACGIH TLV UNITS
Oxygen	99.5+	7782-44-7	None OSHA 1989 TWA - None Listed

## SECTION III--PHYSICAL DATA

BOILING POINT (°F.): -297 SPECIFIC GRAVITY (H<sub>2</sub>O=1): N/A (Gas)  
VAPOR PRESSURE: @ 70°F \* % VOLATILE BY VOLUME: N/A (Gas)  
VAPOR DENSITY (AIR=1): @ 70°F = 1.11 EVAPORATION RATE (BUTYL ACETATE=1): N/A  
SOLUBILITY IN WATER: Slightly (Gas)  
APPEARANCE AND ODOR: Colorless, odorless gas  
\* Above critical temperature

## SECTION IV--FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):	N/A	FLAMMABLE LIMITS:	LEL	UEL
EXTINGUISHING MEDIA:			N/A	N/A

Fires with oxygen as the oxidizer should be fought with copious quantities of water.

SPECIAL FIRE FIGHTING PROCEDURES: If possible, stop the source of oxygen which is supporting the fire. Use water spray to cool surrounding containers.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vigorously accelerates combustion. Many compounds which are not flammable in air may burn in pure oxygen. If cylinders are involved in a fire, safely relocate or keep cool with water spray.

## SECTION V--HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation?	Yes	Skin?	No	Ingestion?	No
Carcinogenicity:	NTP?	No	IARC Monographs?	No	OSHA?	No

### EFFECTS OF OVEREXPOSURE:

Inhalation: Oxygen is the vital element in the atmosphere in which we live and breathe. The atmosphere contains approximately 21 molar % oxygen. Breathing higher concentrations could lead to hyperoxia and pneumonia or could present a risk of inflammation of organic matter in the body.

Persons in ill health where such illness would be aggravated by exposure to higher than normal levels of oxygen should not be allowed to work with or handle this product.

(Continued on Supplemental Sheet)



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**SECTION VI--REACTIVITY DATA**

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STABILITY: UNSTABLE ( ) STABLE ( X )  
CONDITIONS TO AVOID: N/A  
INCOMPATIBILITY (MATERIALS TO AVOID): All flammable materials  
HAZARDOUS DECOMPOSITION PRODUCTS: None  
HAZARDOUS POLYMERIZATION: MAY OCCUR ( ) WON'T OCCUR ( X )  
CONDITIONS TO AVOID: N/A

---

**SECTION VII--SPILL OR LEAK PROCEDURES**

---

**STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:**

Stop leak if possible. Be cognizant of increased flammability possibility in high oxygen content environments. Evacuate personnel from affected area. Remove sources of heat and ignition.

**WASTE DISPOSAL METHOD:**

Locate leaking containers in a downwind location and allow to vent to atmosphere.

---

**SECTION VIII--SPECIAL PROTECTION INFORMATION**

---

RESPIRATORY PROTECTION: N/A

VENTILATION: LOCAL EXHAUST ( X ) To prevent accumulation above  
MECHANICAL (GENERAL) ( X ) 25 molar %

PROTECTIVE GLOVES: Any material

EYE PROTECTION: Safety goggles or glasses

**OTHER PROTECTIVE EQUIPMENT:**

Safety shoes, safety shower. Use appropriate protective equipment when welding or cutting.

---

**SECTION IX--SPECIAL PRECAUTIONS**

---

**PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:**

Protect cylinders against physical damage. Store in cool, dry, well-ventilated area away from sources of heat or direct sunlight. Do not allow areas where cylinders are stored to exceed 125°F. Use a check valve or trap in the cylinder discharge line to prevent hazardous backflow. Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Keep oil, grease and all flammables away. Do not store with flammable gases. Open oxygen valves slowly.

**OTHER PRECAUTIONS:**

Use only DOT or ASME coded vessels. Use a pressure reducing regulator when connecting cylinder to lower pressure piping or systems. Oxygen equipment must be cleaned and degreased for oxygen service. Close valve after each use and when empty. Cylinders may not be refilled except by or with the consent of Liquid Carbonic. For further information refer to CGA Pamphlets P-1, G-4.1, and P-14 which have to do with cylinder handling, oxygen-rich atmospheres and cleaning for oxygen service.

(Continued on Supplemental Sheet)

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SUPPLEMENTAL SHEET - OXYGEN MATERIAL SAFETY DATA SHEET

SECTION V--HEALTH HAZARD DATA - Continued

EMERGENCY AND FIRST AID PROCEDURES:

If Inhaled: Conscious persons should be assisted to an uncontaminated area and breathe fresh air. They should be kept warm and quiet. The physician should be informed that the victim is experiencing (has experienced) hyperoxia.

Unconscious persons should be moved to an uncontaminated area and given assisted respiration. When breathing has been restored, treatment should be as above. Continued treatment should be symptomatic and supportive.

CAUTION: Welding or brazing may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z-49.1 "Safety in Welding and Cutting" published by the American Welding Society and OSHA safety regulations under 29 CFR 1910.252 "Welding, Cutting and Brazing." Also see ACGIH TLVs 1991-1992 Appendix B, Section B2, "Welding Fumes." ARC RAYS can injure eyes and burn skin.

SECTION IX--SPECIAL PRECAUTIONS

OTHER PRECAUTIONS: (Continued)

Consult manufacturer's MSDS sheet on welding consumables and related products for reactivity and health hazard data, and for further information regarding welding fumes.

Reporting under SARA, Title III, Section 313, not required.

NFPA 704 NO. for gaseous oxygen = 0 0 0 (OX)

# MATERIAL SAFETY DATA SHEET



LIQUID CARBONIC INDUSTRIES

810 JORIE BLVD. - OAK BROOK, IL 60521-2216 - 708 572-7500

NITROGEN, COMPRESSED

DOT: UN 1066  
HAZ.CL.: Division 2.2  
LABEL: Nonflammable Gas

October 1991

24 Hour Emergency Phone Numbers: (504) 673-8831; CHEMTREC (800) 424-9300

## SECTION I--PRODUCT IDENTIFICATION

CHEMICAL NAME: Nitrogen  
COMMON NAME AND SYNONYMS: Nitrogen or Nitrogen, Compressed (DOT)  
CHEMICAL FAMILY: Inert Gas FORMULA: N<sub>2</sub>

## SECTION II--HAZARDOUS INGREDIENTS

MATERIAL	VOLUME %	CAS NO.	1991-1992 ACGIH TLV UNITS
Nitrogen	99.9+	7727-37-9	Simple Asphyxiant* OSHA 1989 TWA - None Listed

\*Oxygen levels should be maintained at greater than 18 molar % at normal atmospheric pressure (pO<sub>2</sub>>135 torr).

## SECTION III--PHYSICAL DATA

BOILING POINT (°F.):	-320.5	SPECIFIC GRAVITY (H <sub>2</sub> O=1):	N/A (Gas)
VAPOR PRESSURE:	*	% VOLATILE BY VOLUME:	N/A (Gas)
VAPOR DENSITY (AIR=1):	@ 70°F = 0.97	EVAPORATION RATE (BUTYL ACETATE=1):	N/A (Gas)
SOLUBILITY IN WATER:	Very slightly		
APPEARANCE AND ODOR:	Colorless, odorless gas		

\* Above the critical temperature of -233°F

## SECTION IV--FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):	N/A	FLAMMABLE LIMITS:	LEL	UEL
EXTINGUISHING MEDIA:	Nonflammable, Inert Gas		N/A	N/A
SPECIAL FIRE FIGHTING PROCEDURES:	N/A			

### UNUSUAL FIRE AND EXPLOSION HAZARDS:

If cylinders are involved in a fire, safely relocate or keep cool with water spray.

## SECTION V--HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation?	Yes	Skin?	No	Ingestion?	No
Carcinogenicity:	NTP?	No	IARC Monographs?	No	OSHA?	No

### EFFECTS OF OVEREXPOSURE:

Inhalation: Overexposure to high concentrations so as to exclude an adequate supply of oxygen to the lungs causes dizziness, drowsiness and eventual unconsciousness. Persons in ill health where such illness would be aggravated by exposure to nitrogen should not be allowed to work with or handle this product.

### EMERGENCY AND FIRST AID PROCEDURES:

If Inhaled: Remove to fresh air. If unconscious or breathing is difficult, administer artificial respiration with supplemental oxygen. Keep warm and at rest. Caution when entering contaminated areas to ventilate to acceptable oxygen levels. See CGA Bulletin SB-2 "Oxygen Deficient Atmospheres."



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**SECTION VI--REACTIVITY DATA**

---

STABILITY: UNSTABLE ( ) STABLE ( x )

CONDITIONS TO AVOID: None

INCOMPATIBILITY (MATERIALS TO AVOID): None

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION: MAY OCCUR ( ) WON'T OCCUR ( x )

CONDITIONS TO AVOID: None

---

**SECTION VII--SPILL OR LEAK PROCEDURES**

---

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

Evacuate all personnel upwind and away from affected area. Stop leak if possible. If leaking container(s) is (are) in an enclosed area, ventilate to acceptable respirable oxygen level before entering.

WASTE DISPOSAL METHOD:

Locate leaking containers in a remote downwind area outside and allow to vent to atmosphere. Follow all federal, state and local regulations.

---

**SECTION VIII--SPECIAL PROTECTION INFORMATION**

---

RESPIRATORY PROTECTION: In event of major leak, self-contained breathing apparatus may be required.

VENTILATION: LOCAL EXHAUST ( x ) To prevent accumulation so as to exclude an adequate oxygen supply  
MECHANICAL (GENERAL) ( x )

PROTECTIVE GLOVES: Any material

EYE PROTECTION: Safety goggles or glasses

OTHER PROTECTIVE EQUIPMENT: Safety shoes

---

**SECTION IX--SPECIAL PRECAUTIONS**

---

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

Protect cylinders against physical damage. Store in cool, dry, well-ventilated area away from sources of heat or direct sunlight. Do not allow areas where cylinders are stored to exceed 125°F. Use a check valve or trap in the cylinder discharge line to prevent hazardous backflow. Cylinders should be stored upright and firmly secured to prevent falling or being knocked over.

OTHER PRECAUTIONS:

Use only DOT or ASME coded containers. Use a pressure reducing regulator when connecting cylinder to lower pressure piping or systems. Close valve after each use and when empty. For more information refer to CCA Pamphlet P-1 "Safe Handling of Compressed Gases in Containers." Cylinders may not be refilled except by or with the consent of Liquid Carbonic.

Reporting under SARA, Title III, Section 313 not required.

NFPA 704 NO. for gaseous nitrogen = 1 0 0

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No. 199

AR307700

TOTAL P.11

# MATERIAL SAFETY DATA SHEET

GENTUM PUBLISHING CORPORATION

1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854



MSDS # 100

METHYL ALCOHOL

Revision 1

Issued:

Revised: September, 1984

From Gentum's MSDS Collection, to be used as a reference.

## SECTION 1. MATERIAL IDENTIFICATION

MATERIAL NAME: METHYL ALCOHOL

OTHER DESIGNATIONS: Methanol, Wood Alcohol, Carbinol, Wood Naphtha, Methyl Hydroxide, Monohydroxy Methane, CH<sub>3</sub>OH, CAS #67-56-1

MANUFACTURER/SUPPLIER: Available from several suppliers,

including: E.I. DuPont DeNemours & Co. (302- 774-2290

Chemicals & Pigments Dept (800) 441-9442

1007 Market St. Wilmington, DE 19898



## SECTION 2. INGREDIENTS AND HAZARDS

METHYL ALCOHOL



\* Current OSHA Standard; ACGIH (1985-86) TLV adds (skin) notation.

NIOSH has recommended a TWA standard of 200 ppm with a fifteen minute ceiling of 800 ppm. This ceiling is well above the TLV STEL of 250 ppm.

%

ca 100

### HAZARD DATA

8 hr TWA: 200 ppm, or  
260 mg/m<sup>3</sup> (Skin)  
STEL: 250 ppm, or  
310 mg/m<sup>3</sup>

#### HUMAN

Eye: 5 ppm, primary  
irritation dose

Oral: LDLo: 340 mg/kg

Inhalation: TCLo: 86,000  
mg/m<sup>3</sup> - Toxic irritant  
effects (systemic)

## SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm ..... 148.5°F (64.7°C)

Vapor density (Air=1) ..... 1.11

Vapor pressure @ 21°C, mmHg ... 100

@ 50°C, mmHg ... 400

Water Solubility ..... Totally Miscible

Viscosity @ 20°C, cps ..... 0.59

Specific gravity, 20°/4°C ... 0.791

Melting point ..... -144°F (-97.8°C)

Volatiles, % ..... ca 100

Evaporation rate (BuAc=1) ... 5.9

Molecular weight ..... 32.04

APPEARANCE & ODOR: Clear, colorless, highly polar liquid with a characteristic alcohol odor. The odor recognition threshold (100% of test panel) is 53.3 ppm

## SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
60.8°F (12°C) Closed Cup	725°F (385°C)	% by Volume	6	36.5

**EXTINGUISHING MEDIA:** Use carbon dioxide, dry chemical, or alcohol type foam. Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool fire-exposed tanks/containers. Fires involving Methyl Alcohol are Class IB; use a blanketing effect to smother fire. Methyl Alcohol is a moderate explosion hazard and a dangerous fire hazard when exposed to heat, sparks, flame or oxidizers. Its vapors are heavier than air and may travel a considerable distance to an ignition source and flashback. Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving Methyl Alcohol.

## SECTION 5. REACTIVITY DATA

Methyl Alcohol is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. This material may react violently with chromic anhydride; iodine plus ethyl alcohol, and mercuric oxide; lead perchlorate; perchloric acid plus ethyl alcohol; dimethyl formamide plus phosphorous; potassium hydroxide plus chloroform; sodium hydroxide plus chloroform. It may also react with metallic zirconium at high temperatures.

Methyl Alcohol is incompatible with strong oxidizing agents (eg., nitrates, perchlorate or sulfuric acid), active metals, acetaldehyde, ethylene oxide, isocyanates, beryllium dihydride, chloroform, and potassium tert-butoxide. It may attack some forms of plastics and rubber. Thermal decomposition or burning will produce carbon monoxide, carbon dioxide and possible toxic formaldehyde and unburned methanol.

## SECTION 6. HEALTH HAZARD INFORMATION

TLV 200 ppm (skin not to be used)

Methanol is a poisonous, narcotic chemical that may exert its effects through inhalation, skin absorption, or ingestion. Elimination of Methanol from the body is slow, and the toxic effects can be compounded by repeated excessive exposures over several days. Toxic effects are exerted upon the CNS, especially the optic nerve and possibly the retinae. Symptoms of overexposure include dizziness, visual impairment, nausea, respiratory failure, muscular incoordination and narcosis. Visual disturbances may clear temporarily then re-occur and progress to blindness. Prolonged or repeated contact with the skin may cause dermatitis, erythema, and scaling. Vapors of Methanol are mildly irritating to the eyes, while direct contact with the liquid may cause irritation, pain and transient corneal opacity. Ingestion of Methanol can cause blindness and death. The fatal dose is 100-150 ml, although death from ingestion of less than 55 ml has been reported.

**FIRST AID:** **EYE CONTACT:** Immediately flush eyes, including under eyelids, with plenty of running water for at least 15 minutes. Get medical attention if irritation persists. **SKIN CONTACT:** Flush exposed area with water while removing contaminated clothing. Wash with soap and water. Get medical attention if irritation persists. **INHALATION:** Remove victim to fresh air. Restore and/or support breathing as needed. Get medical help (Inplant Paramedic, community). **INGESTION:** Give victim 3-4 glasses of water or milk and induce vomiting by sticking finger to back of throat. Contact a Poison-Control Center or physician. Transport victim to a medical facility immediately. Do not induce vomiting or give anything to drink if victim is unconscious or having convulsions. Get medical attention (Inplant, paramedic, community).

## SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from the area except for those involved in clean-up. Remove leaking container to safe place if feasible. Clean-up personnel should wear protective clothing, gloves, boots, and a self-contained breathing apparatus. Absorb small quantities on paper towel, vermiculite, or other absorbent and place in closed container for disposal. Dike large spills and collect for reclamation or disposal. Water spray may be used to knock down vapor and to dilute and flush spill away from sensitive areas. Do not flush to sewer. Keep out of watersheds and waterways.

**DISPOSAL:** Place in suitable container for disposal by a licensed contractor or burn in an approved incinerator. Waste solvent may be reclaimed via filtration and distillation procedures. Methyl Alcohol has been designated as a hazardous waste by the EPA (RCRA CFR 261.33). The EPA Hazardous Waste No. is U154. Aqueous Toxicity Rating: TLV96: Over 1000 ppm.

## SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements. For emergency or non-routine exposures where the TLV may be exceeded, wear an appropriate NIOSH-approved respirator. All electrical service in use or storage areas should have an explosion-proof design.

Prevent skin and eye contact by wearing rubber gloves and splash goggles or safety glasses. Use protective aprons, boots and face shield as necessary when splashing may occur.

Eyewash stations and safety showers should be available in areas of use and handling. Provide suitable training to those working with Methanol. Monitor the workplace and keep accurate records.

Contact lenses pose a special hazard, soft lenses may absorb and all lenses concentrate irritants.

## SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in tightly closed containers in a dry, well-ventilated area away from strong oxidizing agents, heat, sparks and open flame. Protect container from physical damage. When transferring or pouring Methyl Alcohol, ground and bond containers and equipment to prevent static sparks. Use non-sparking tools.

Do not smoke in areas of use or storage. Use with adequate ventilation. Do not breathe vapors. Avoid contact with eyes and skin. This material is poisonous when introduced into the body metabolism. **DO NOT INGEST!!!**

Provide preplacement medical exams and periodic medical surveillance for industrially exposed workers with emphasis on neurological and visual functions, liver, and kidney systems.

**DOT CLASSIFICATION:** Flammable liquid, UN1230

**DOT LABEL:** Flammable liquid.

**DATA SOURCE(S) CODE (See Glossary)** 1, 2, 4-12, 16, 19, 20, 23-26, 31, 34, 37-39, 43, 47, 63, 79, R.

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**APPROVALS**

*APR 11/85*

**INDUST. HYGIENE/SAFETY**

*APR 11/85*

**MEDICAL REVIEW:**

*APR 11/85*

# MATERIAL SAFETY DATA SHEET

(Essentially Similar to Form OSHA-20)

## SECTION I

PRODUCT NAME	MSA CLEANER-SANITIZER II		
MANUFACTURER	Mine Safety Appliances Company 600 Penn Center Boulevard Pittsburgh, PA 15235	FORMULA CODE	8599-03
		COMPLETED BY	L. P. Dewosky
		TITLE	Mgr. Product Safety
EMERGENCY PHONE NO.	412-273-5500	DATE	5-17-81

## SECTION II - INGREDIENTS

	<u>CAS NUMBER</u>	<u>WEIGHT, %</u>
<b>ACTIVE INGREDIENTS:</b>		54.7
SODIUM CARBONATE	497-19-8	42.2
TRISODIUM PHOSPHATE	7601-54-9	10.0
ALKYL (C14, 50%; C12, 40%; C16, 10%)		
DIMETHYL BENZYL AMMONIUM CHLORIDES	139-08-2	2.5
 <b>INERT INGREDIENTS:</b>		 45.3
SODIUM TRIPOLYPHOSPHATE	7758-29-4	
SODIUM BICARBONATE	144-55-8	
WATER	7732-18-5	
ISOMERIC LINEAR ALCOHOLS (C11-C15)		
POLYETHOXY ETHANOLS	68131-40-8*	
ETHANOL	64-17-5	
ISOBORNYL ACETATE	125-12-2	

## SECTION III - PHYSICAL DATA

BOILING POINT (° F.)	NA	SPECIFIC GRAVITY (H <sub>2</sub> O=1)	0.8
VAPOR PRESSURE (mm Hg.)	NA	%VOLATILE BY VOLUME	NA
VAPOR DENSITY (AIR=1)	NA	EVAPORATION RATE (_____ = 1)	NA
SOLUBILITY IN WATER	20%	PH 1% AQUEOUS SOLUTION	9.5 - 10.5
APPEARANCE AND ODOR	FRAGRANT BLEND OF WHITE POWDERS		

## SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT (Method used)	NO FLASH TO 240 F	FLAMMABLE LIMITS	L <sub>o</sub> NA    U <sub>o</sub> NA
EXTINGUISHING MEDIA	WATER SPRAY (FOG), FOAM, DRY CHEMICAL, CARBON DIOXIDE		
SPECIAL FIRE FIGHTING PROCEDURES	BLANKET FIRE WITH EXTINGUISHING MEDIUM		
UNUSUAL FIRE AND EXPLOSION HAZARDS	PRODUCT IS NONREACTIVE AND DOES NOT READILY SUPPORT COMBUSTION		

AR307703

SKIN CONTACT WITH POWDER MAY CAUSE BURNS. FLUSH AFFECTED AREA WITH CLEAN WATER.

EYE CONTACT WITH POWDER MAY CAUSE CORNEAL BURNS. AVOID RUBBING EYES BECAUSE WATER INSOLUBLE PARTICLES MAY SCRATCH CORNEA. IMMEDIATELY FLUSH EYES WITH CLEAN WATER WHILE HOLDING EYELIDS APART. CONTINUE FLUSHING FOR AT LEAST 15 MINUTES OR UNTIL IRRITATION SUBSIDES.

CONSULT PHYSICIAN AS SOON AS POSSIBLE.

INHALATION OF A LARGE ENOUGH QUANTITY TO POSE A SIGNIFICANT HEALTH HAZARD IS IMPROBABLE.

INGESTION OF POWDER IS HARMFUL OR FATAL. SHOULD INGESTION OCCUR, DRINK MILK, RAW EGG WHITE, OR GELATIN SOLUTION, OR LARGE QUANTITIES OF WATER. AVOID ALCOHOL. CONSULT PHYSICIAN AS SOON AS POSSIBLE.

## SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID	NONE
	STABLE	X		
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID	NONE
	WILL NOT OCCUR	X		
HAZARDOUS DECOMPOSITION PRODUCTS	UNDETERMINED			
INCOMPATIBILITY (MATERIALS TO AVOID)	OXIDIZING AGENTS SOAP AND ANIONIC SURFACTANTS DEACTIVATE GERMICIDE			

## SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	SWEEP UP
WASTE DISPOSAL METHOD	REMOVE TO SANITARY LANDFILL AWAY FROM WATER SUPPLIES DESTROY EMPTY CONTAINERS

## SECTION VIII - SPECIAL PROTECTION INFORMATION

SPECIAL RESPIRATORY PROTECTION	NOT REQUIRED
SPECIAL SKIN PROTECTION	NOT REQUIRED
SPECIAL EYE PROTECTION	NOT REQUIRED

## SECTION IX - SPECIAL PRECAUTIONS

SPECIAL HANDLING PRECAUTIONS	NOT REQUIRED
SPECIAL STORAGE PRECAUTIONS	NOT REQUIRED. MINIMUM SHELF LIFE 6 MONTHS. FOR MAXIMUM SHELF LIFE AVOID HIGH HUMIDITY AND STORE IN A CLEAN, DRY PLACE.
OTHER SPECIAL	NOT REQUIRED

AR307704

**MATERIAL SAFETY DATA SHEET**  
CPK 1910.1200 OSHA Hazard  
Communication Rule Format

MINE SAFETY APPLIANCE COMPANY  
600 Penn Center Boulevard  
Pittsburgh, PA 15235  
PHONE (412) 273-5000

**PRODUCT IDENTITY**

**LABEL IDENTITY -** MSA P/N 478191 Calibration Check Gas, 60 ppm Carbon Monoxide, 0.75%  
Pentane, 15% Oxygen, Balance Nitrogen

**CHEMICAL NAME -** Carbon Monoxide, Pentane, Oxygen, Nitrogen Mixture

**ADDITIONAL IDENTITIES -** MSA P/N 478191 Calibration Gas

**FORMULA -**  $\text{CO} + \text{C}_5\text{H}_{12}$  in  $\text{O}_2 + \text{N}_2$

**APPLICABLE CHEMICAL CONTENTS**

	%	TLV
Carbon Monoxide (CAS 630-08-0), STEL 400 ppm (ACGIH 1984-85)	0.0060	50 ppm
Pentane (CAS 109-66-0), STEL 750 ppm (ACGIH 1984-85)	0.75	0.06%
Oxygen (CAS 7782-44-7)	15	None
Nitrogen (CAS 7727-37-9)	Balance	None

Gas Under Pressure, 800 PSIG at 70°F  
Approx. 80 Liters Gas at Atmospheric Pressure

**PHYSICAL AND CHEMICAL PROPERTIES**

**APPEARANCE AND ODOR -** Colorless Gas, Faint Hydrocarbon Odor

**BOILING POINT -** N/A      **SPECIFIC GRAVITY ( $\text{H}_2\text{O} = 1$ ) -** N/A

**VAPOR PRESSURE -** N/A      **PERCENT VOLATILE BY VOLUME -** N/A

**VAPOR DENSITY (AIR = 1) -** Approx. 1

**SOLUBILITY IN WATER -**

Carbon Monoxide	--	3.5 $\text{cm}^3/100 \text{ ml}$ (0°C)
Pentane	--	11 $\text{cm}^3/100 \text{ ml}$ (16°C)
Oxygen	--	3.2 $\text{cm}^3/100 \text{ ml}$ (25°C)
Nitrogen	--	2.3 $\text{cm}^3/100 \text{ ml}$ (0°C)



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PHYSICAL HAZARD INFORMATION

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PHYSICAL HAZARD - Compressed Gas 800 PSIG at 70°F

CONDITIONS OR MATERIALS TO AVOID - None

FLASH POINT - N/A

(Pentane) LEL (1.4%)

UEL (8.0%)

EXTINGUISHING MEDIA - This Gas Mixture is Not Flammable

SPECIAL FIRE FIGHTING PROCEDURES - See Next Item

USUAL FIRE AND EXPLOSION HAZARDS - Gas Under Pressure, 800 PSIG at 70°F. Do Not Exceed 1

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HEALTH HAZARDS

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HEALTH HAZARDS - Pentane may be irritating to mucous membranes.

SIGNS AND SYMPTOMS OF EXPOSURE - Respiratory Tract Irritation

PRIMARY ROUTES OF ENTRY - Inhalation

TARGET ORGANS - Pentane: Respiratory Tract

CO: Lungs, Blood, Tissues. CO at high concentrations causes tissue hypoxia (lack of oxygen) by preventing blood from transporting sufficient oxygen

CONDITIONS GENERALLY RECOGNIZED AS BEING AGGRAVATED BY EXPOSURE - No Information

SAFE LIMITS - ACGIH, Carbon Monoxide 50 ppm STEL 400 ppm, Pentane 600 ppm. Pentane STEL 750 ppm (1984-85)

GENOTOXICITY DATA - Component Gases Not Listed in NIOSH RTECS.

EMERGENCY AND FIRST AID PROCEDURES - Remove From Exposure

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#### SAFE HANDLING AND USE

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HYGIENIC PRACTICES - Avoid Breathing Gas

PREVENTIVE MEASURES DURING REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT - Not Applicable

PROCEDURES FOR SPILL OR LEAK CLEANUP - Ventilate Area. Avoid Breathing Gas.

**SAFE DISPOSAL** - Do not puncture or incinerate cylinder. Before discarding cylinder, slowly release contents to a safe exhaust.

**STORAGE** - Store in a cool, dry, well-ventilated area. Do not exceed 120°F.

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#### CONTROL MEASURES

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**PERSONAL PROTECTIVE EQUIPMENT** - Due to the limited amount of gas in the cylinder, and the low release rate employed in instrument calibration, respirator protection is not indicated under conditions of intended use.

**ENGINEERING CONTROLS** - Mechanical ventilation is suitable.

**USE PRACTICES** - Avoid breathing gas. Use in well-ventilated areas. Follow the calibration procedure detailed in the MSA instruction manual provided with the instrument under calibration.

**DATE OF PREPARATION** - September 1985

The information provided herein has been compiled from sources believed to be reliable. However, Mine Safety Appliances Company makes no warranty as to the accuracy, completeness, efficiency of the information and in no event will Mine Safety Appliances Company be responsible for loss or damage of any nature whatsoever resulting from use of the information.



signs and symptoms of pulmonary insufficiency. In severe exposures, death due to asphyxia may occur within a few hours after onset of the symptoms of pulmonary edema or following a relapse.  
**CHRONIC EXPOSURE**- Depending on the concentration and duration of exposure, repeated or prolonged exposure to an acidic substance may cause erosion of the teeth, inflammation and ulcerative changes in the mouth, and possibly bronchitis. Bronchial irritation with cough and frequent attacks of bronchial pneumonia may occur. Gastrointestinal disturbances are also possible.

**FIRST AID**- Remove from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Bathe skin, always and blood pressure and administer oxygen if available. Keep affected person warm and at rest. Treat symptomatically and supportively. Administration of oxygen should be performed by qualified personnel. Get medical attention immediately.

**SKIN CONTACT:**

**CORROSIVE:**

**ACUTE EXPOSURE**- Direct contact with liquid or vapor may cause severe pain, burns and possibly yellowish stains. Burns may be deep with sharp edges and heal slowly with scar tissue formation. Dilute solutions of nitric acid may produce mild irritation and harden the epidermis without destroying it. Concentrated acid solutions applied to over 25% of the skin area in rats produced elevated methemoglobin and blood nitrate levels.  
**CHRONIC EXPOSURE**- Effects depend on the concentration and duration of exposure. Repeated or prolonged contact with acidic substances may result in dermatitis or effects similar to acute exposure.

**FIRST AID**- Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). In case of chemical burns, cover area with sterile, dry dressing. Bandage securely, but not too tightly. Get medical attention immediately.

**EYE CONTACT:**

**CORROSIVE:**

**ACUTE EXPOSURE**- Direct contact with acidic substances may cause pain and irritation, photophobia and blurred vision. The degree of injury depends on the concentration and duration of contact. In mild burns, the epithelium regenerates rapidly and the eye recovers completely. In severe cases, the extent of injury may not be fully apparent for several weeks. Ultimately, the whole cornea may become deeply vascularized and opaque resulting in blindness. In the worst cases, the eye may be totally destroyed. Concentrated nitric acid may impart a yellow color to the eye upon contact.

**CHRONIC EXPOSURE**- Effects depend on the concentration and duration of exposure. Repeated or prolonged exposure to acidic substances may cause conjunctivitis or effects as in acute exposure.

**FIRST AID**- Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. Get medical attention immediately.

**INGESTION:**

**CORROSIVE/TOXIC:**

**ACUTE EXPOSURE**- Acidic substances may cause circumoral burns with yellow discoloration and corrosion of the mucous membranes of the mouth, throat and esophagus. There may be immediate pain and difficulty or inability to swallow or speak. Epiglottic edema may result in respiratory distress and possibly asphyxia. Marked thirst, epigastric pain, nausea, vomiting and diarrhea may occur. Depending on the degree of esophageal and gastric corrosion, the vomitus may contain fresh or dark precipitated blood and large shreds of mucus. Shock with marked hypotension, weak, rapid pulse, shallow respiration, and clammy skin may occur. Circulatory collapse may ensue, and if uncorrected, lead to renal failure. In severe cases, hemorrhage may occur and degrees, accompanied by fever and abdominal rigidity. Esophageal gastric and pyloric strictures may occur within a few weeks, but may be delayed for months or even years. Death may result within a short time from asphyxia, circulatory collapse or aspiration of even minute amounts. Later death may be due to peritonitis, severe nephritis or pneumonia. Come and convulsions sometimes occur terminally.

**CHRONIC EXPOSURE**- Depending on the concentration, repeated ingestion of acidic substances may result in inflammatory and ulcerative changes in the mucous membranes of the mouth and other effects as in acute ingestion. Reproductive effects have been reported in animals.

**FIRST AID**- Do not use gastric lavage or emesis. Dilute the acid immediately by drinking large quantities of water or milk. If vomiting persists, induce vomiting by drinking fluids repeatedly. Do not induce vomiting if the patient is unconscious. If vomiting occurs, keep head below hips to help prevent

aspiration.

**ANTIDOTE:**

No specific antidote. Treat symptomatically and supportively.

**REACTIVITY**

**REACTIVITY:**

Reacts exothermically with water.

**INCOMPATIBILITIES:**

**NITRIC ACID:**  
ACETIC ACID: May react explosively.  
ACETIC ANHYDRIDE: Explosive reaction by friction or impact.  
ACETONE: May react explosively.  
ACETONITRILE: Explosive mixture.  
4-ACETOXY-3-METHOXYBENZALDEHYDE: Exothermic reaction.  
ACROLEIN: Temperature and pressure increase in closed container.  
ACRYLONITRILE: Explosive reaction at 80 C.  
ALCOHOLS: Possible violent reaction or explosion; formation of explosive compound in the presence of heavy metals.  
ALKANETHIOLS: Exothermic reaction with possible ignition.  
ALLYL ALCOHOL: Temperature and pressure increase in closed container.  
ALLYL CHLORIDE: Temperature and pressure increase in closed container.  
AMINES (ALIPHATIC OR AROMATIC): Possible ignition in closed container.  
2-AMINOETHANOL: Explosive reaction.  
AMMONIA (GAS): Burns in an atmosphere of nitric acid vapor.  
AMMONIUM HYDROXIDE: Temperature and pressure increase in closed container.  
AMMONIUM NITRATE: Forms explosive mixture.  
ANILINE: Ignites on contact.  
ANILINUM NITRATE: Forms explosive solution.  
ANION EXCHANGE RESINS: Possible violent exothermic reaction.  
ANTIMONY: Violent reaction.  
ARSENIC: Explosive reaction.  
GASES: BENZENE: Violent oxidation.  
BENZENE: Exothermic reaction.  
BENZIDINE: Spontaneous ignition.  
BENZONITRILE: Possible explosion.  
BENZOTHIOPHENE DERIVATIVES: Formation of possibly explosive compounds.  
N-BENZYL-N-ETHYLANILINE: Vigorous decomposition.  
1,4-BIS(METHOXYMETHYL) 3,5,5-TETRAMETHYLBENZENE: Gas evolution.  
BISMUTH: Intense exothermic reaction or explosion.  
1,3-BIS(TRIFLUOROMETHYL)BENZENE: Possible explosion.  
BORON: Violent reaction with incandescence.  
BORON DECAHYDRIDE: Explosive reaction.  
BORON PHOSPHIDE: Ignition reaction.  
BROMINE PENTACHLORIDE: Ignition reaction.  
N-BUTYLALCOHOL: Temperature and pressure increase in closed container.  
CADIUM PHOSPHIDE: Exothermic reaction.  
CALCIUM HYDROPHOSPHITE: Ignition reaction.  
CARBON (PULVERIZED): Violent reaction.  
CELLULOSE: Forms easily combustible ester.  
CHLORATES: Reacts.  
CHLORINE: Incompatible.  
CHLORINE TRIFLUORIDE: Violent reaction.  
CHLOROBENZENE: Possible explosion.  
4-CHLORO-2-NITROANILINE: Forms explosive compound.  
CHLORSULFONIC ACID: Temperature and pressure increase in closed container.  
COAL: Explosive mixture.  
COPPER: May be attacked.  
COPPER SULFATE: Temperature and pressure increase in closed container.  
CROTONALDEHYDE: Violent reaction with ignition.  
CUMENE: Temperature and pressure increase in closed container.  
CUPRIC NITRIDE: Violent reaction.  
CYANATES: Possible explosive reaction.  
CYCLOHEXANONE: Violent reaction.  
CYCLOHEXANOL: Violent reaction.  
CYCLOPENTADIENE: Explosive reaction.  
1,2-DIAMINOTHANES(BIS(TRIMETHYLGOLD)): Explosive reaction.  
DIBORANE: Spontaneous ignition.  
2,6-DI-T-BUTYL-PHENOL: Violent decomposition reaction.  
DICHLOROETHANE: Forms shock and heat sensitive mixture.  
DICHLOROMETHANE: Forms explosive compound.  
DICHLOROMETHANE: Forms explosive compound.  
DICYCLOPENTADIENE: Spontaneous ignition.  
DIENES: Ignition reaction.  
DIETHYLAMINO ETHANOL: Possible explosion.  
DIETHYL ETHER: Possible explosion.  
3,6-DIHYDRO-1,2,4-OXAZINE: Explosive interaction.  
DISOPROPYL ETHER: Temperature and pressure increase in closed container.  
DIMETHYLAMINOMETHYLPERFEROENE: Violent decomposition if heated.  
DIMETHYL ETHER: Forms explosive compound.



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Protect against physical damage. Separate from metallic powders, carbides, hydrocarbons, acids, and other hazardous materials. Provide good ventilation and avoid direct sunlight (MSHA 49, Hazardous Chemicals Data, 1975).

Store away from incompatible substances.

Threshold Planning Quantity (TPQ):  
The Superfund Amendments and Reauthorization Act (SARA) Section 302 requires that each facility where an extremely hazardous substance is present in a quantity equal to or greater than the TPQ established for that substance notify the state emergency response commission for the state in which it is located. Section 303 of SARA requires that facilities to participate in local emergency response planning (40 CFR 355.30).

Threshold quantity (TQ): 500 pounds  
The Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard requires that facilities utilizing a process which involves a chemical at or above its specified threshold quantity comply with the provisions of 29 CFR 1910.119, Process Safety Management of highly hazardous chemicals.

#### \*\*Disposal\*\*

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262, EPA Hazardous Waste Number D002.  
100 pound CERCLA Section 103 Reportable Quantity.

#### CONDITIONS TO AVOID

May ignite other combustible materials (wood, paper, oil, etc.). Reacts violently with water and fuels. Flammable, poisonous gases may accumulate in tanks and hopper cars. Runoff to sewer may create fire or explosion hazard.

Consult NFPA publication 43A, Storage of Liquid and Solid Oxidizing Materials, for storage requirements.

#### SPIII AND LEAK PROCEDURES

**SOIL SPILL:**  
Dig a holding area such as a pit, pond or lagoon to contain spill and dike surface flow using barrier of soil, sand, cement, foam, polyethylene or foamed concrete. Absorb liquid mass with fly ash or cement powder.

Neutralize spill with slaked lime, sodium bicarbonate or crushed limestone.

**AIR SPILL:**  
Apply water spray to knock down and reduce vapors. Knock-down water is corrosive and toxic and should be diked for containment and later disposal.

**WATER SPILL:**  
Add suitable agent to neutralize spilled material to pH-7.

**OCCUPATIONAL SPILL:**  
Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not touch spilled material. Stop leak if you can do it without risk. Use water spray to reduce vapors. Do not get water inside container. For small spills, flush area with floodings amount of water. For large spills, dike (or sand) off spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry. Ventilate closed spaces before entering.

Reportable Quantity (RQ): 1000 pounds  
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2875 in the metropolitan Washington, D.C. area (40 CFR 302.6).

#### PROTECTIVE EQUIPMENT

**VENTILATION:**  
Process enclosure recommended to meet published exposure limits.

**RESPIRATOR:**  
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards: NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.  
The specific respirator selected must be based on contamination levels found in the area, must not exceed the working limits of the respirator, and be approved by the National Institute for Occupational Safety and Health, U.S. Mine Safety and Health Administration (NIOSH-MSHA).

#### NITRIC ACID:

50 ppm- Any supplied-air respirator operated in a continuous-flow mode.

100 ppm- Any self-contained breathing apparatus with a full facepiece.

Any supplied-air respirator with a full facepiece.

Any self-contained breathing apparatus (gas mask) with a

char-style, hood- or back-mounted canister providing

protection against nitric acid.

Any chemical cartridge respirator with a full facepiece and

cartridge(s) providing protection against nitric acid.

Escape- Any self-contained breathing apparatus (gas mask) with a

char-style, hood- or back-mounted canister providing protection

against nitric acid.

Any appropriate escape-type, self-contained breathing apparatus.

Any nonadmittable sorbents are allowed (not charcoal).

Any self-contained breathing apparatus that has a full facepiece and is

operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a

pressure-demand or other positive-pressure mode in combination with an

auxiliary self-contained breathing apparatus operated in pressure-demand

or other positive-pressure mode.

Any self-contained breathing apparatus that has a full facepiece and is

operated in a pressure-demand or other positive-pressure mode.

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AUTHORIZED - FISHER SCIENTIFIC, INC.  
CREATION DATE: 12/04/84 REVISION DATE: 03/03/94

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AR307712

US DEPARTMENT OF LABOR  
Occupational Safety and Health Administration

## MATERIAL SAFETY DATA SHEET

Required under USDL Safety & Health Regulations for Ship Repairing,  
Shipbuilding and Shipbreaking (29 CFR 1915, 1916, 1917)

## SECTION 1

ALLEGRO INDUSTRIES  
6403 E. ALONDRA BLVD.  
PARAMOUNT, CA 90723  
(Ordered from Lab Safety)

Telephone No: (213) 633-4861

PRODUCT:	PRODUCT NO:
Personal Safety Equipment Cleaning Pad (Respirator Wipe Pads)	1001
Chemical Name & Synonyms: Isopropyl Alcohol	Trade Name & Synonyms: Steri-Wipe

Chemical Family:  
Alcohol

Formula:  
CH3CHOHCH3

Prepared by

Date

Thomas J. Johnston

1/5/90

Hazardous mixtures of other  
Liquids, Solids or Gases

%

TLV  
Unit  
400 ppm

Isopropyl Alcohol CAS #67-63-0

70

## SECTION III - PHYSICAL DATA

Boiling Point (°F)	190	Specific Gravity (H <sub>2</sub> O = 1)	0.874
Vapor Pressure (mm Hg)		Percent Volatile by Volume (%)	100%
Isopropyl Alcohol	44		
Density (Air=1)		Evaporation Rate (IPA=1)	0.69
Isopropyl Alcohol	1.06		
Solubility in Water	Soluble		
Appearance & Odor	Colorless liquid, medicinal alcoholic odor		

## SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (method used): 77°F Flammable Limits: L<sub>1</sub> 2 U<sub>1</sub> 12  
TCC

Extinguishing Media: Water, CO<sub>2</sub>, Dry Chemical

Special Fire Fighting Procedures: Self-contained breathing apparatus.

Unusual Fire and Explosion Hazards: None

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SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: 400 ppm, 490 mg/M<sup>3</sup>  
 Effects of Overexposure: Ingestion - Headache, dizziness, nausea, coma.  
 Skin - Dryness Eyes - Irritant  
 Inhalation: headache, dizziness, nausea.  
 Emergency & First Aid Procedures:  
 Ingestion - Consult physician.  
 Skin - Rinse with water. Eyes - Flush with water.  
 Inhalation - Remove to fresh air.

SECTION VI - REACTIVITY DATA

STABILITY:	Unstable	CONDITIONS TO AVOID:
	Stable X	Flame, ignition sources,
Incompatibility (Materials to Avoid):	Oxidizers	
Hazardous Decomposition Products:	CO, CO <sub>2</sub>	
Hazardous Polymerization:		May Occur Will not Occur X

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:  
 Absorb with inert absorbant  
 Waste Disposal Method:  
 Incineration or evaporate and landfill.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection: (Specify Type) Not required.  
 Ventilation: Local Exhaust: May be needed  
 Special: NA  
 Mechanical: (General) Use in well ventilated area.  
 Other: NA  
 Protective Gloves: PVC or rubber Eye Protection: Safety glasses  
 Other protective Equipment: Not required.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storing:  
 Keep away from oxidizers, flame, ignition sources,  
 Other precautions: NA

AR307714

**Genium Publishing Corporation**

1145 Catalyn Street  
Schenectady, NY 12303-1836 USA  
(518) 377-8854

**Material Safety Data Sheets Collection:**

Sheet No. 380  
Propane

Issued: 10/84

Revision: B, 4/90

**Section 1. Material Identification****31**

**Propane Description:** Derived from petroleum and natural gas. Propane is obtained by the so-called "stabilization process" using fractional distillation under pressure. Propane is widely used as a fuel gas, sometimes mixed with butane; as refrigerant, gas enricher, extractant, aerosol propellant, mixture for bubble chambers; in hydrocarbon oxidation, flame control of weeds, and organic synthesis.

**Other Designations:** CAS No. 0074-98-6;  $C_3H_8$ ; dimethylmethane; liquified propane; *n*-propane; propyl hydride.

**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*<sup>(7)</sup> for a suppliers list.

R 1  
I 1  
S 3\*  
K 4  
\* Liquid



HMIS  
H 1  
F 4  
R 0  
PPG†  
† Sec. 8

**Section 2. Ingredients and Occupational Exposure Limits**

Propane, ca 100%

**OSHA PEL**

8-hr TWA: 1000 ppm, 1800 mg/m<sup>3</sup>

**ACGIH TLV, 1989-90\***

None established

**NIOSH REL, 1987**

None established

**Toxicity Data†**

None listed

\* ACGIH (1989-90) labels propane a simple asphyxiant (control at 18 vol % minimum oxygen).

† Monitor NIOSH, RTECS (TX2275000) for additional toxicity data.

**Section 3. Physical Data**

**Boiling Point:** -43.8 °F/-42.1 °C at 1 atm

**Melting Point:** -309.4 °F/-189.7 °C

**Vapor Pressure:** 760 mm Hg at -43.8 °F/-42.1 °C

**Vapor Density (Air = 1):** 1.56 at 32 °F/0 °C

**Molecular Weight:** 44.09 g/mol

**Specific Gravity ( $H_2O = 1$  at 39 °F/4 °C):** 0.58 at -44.0 °F/-42.2 °C

**Water Solubility:** Slightly soluble

**Appearance and Odor:** A colorless gas at room temperature and 1 atm pressure, propane can be liquified by lowering and/or raising the temperature. Liquified propane is an unspecified mixture of propane, various butanes, and propylene. Although odorless when pure, propane can have an odor like natural gas. It has an odor threshold of 5,000 to 20,000 ppm, but odor is not an adequate warning to prevent overexposure.

**Section 4. Fire and Explosion Data**

**Flash Point:** -156 °F/-105 °C

**Autoignition Temperature:** 842 °F/450 °C

**LEL:** 2.1% v/v

**UEL:** 9.5% v/v

**Extinguishing Media:** If feasible, stop flow of gas. Use water to cool fire-exposed containers, tanks, surroundings, and to protect personnel working on shutting off gas flow. If you cannot stop the gas flow, direct water spray, dry powder, or carbon dioxide at flame area. *Do not completely extinguish flame unless gas flow is shut off!* Propane burns with a luminous, smoky flame.

**Unusual Fire or Explosion Hazards:** This material can be a dangerous fire and explosion hazard when mixed with air or exposed to heat and flame. Vapors may flow on surfaces for considerable distances, reach an ignition source, and flash back. One volume of propane requires about 25 volumes of air for complete combustion.

**Special Fire-fighting Procedures:** Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Continue cooling containers with water well after fire is extinguished. Fight massive cargo fires with unmanned hose holders or monitor nozzles. If this is not feasible, withdraw from the area and allow the fire to burn. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

**Section 5. Reactivity Data**

**Stability/Polymerization:** Propane is stable when stored as a liquid in steel tanks under its own vapor pressure. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** Propane reacts vigorously with oxidizers and explosively with chlorine dioxide ( $ClO_2$ ). A violent exothermic reaction occurs with barium peroxide and heat.

**Conditions to Avoid:** Propane can produce carbon monoxide when oxidized with a deficiency of oxygen. When sufficient oxygen is present, burning propane forms carbon dioxide and water. Propane can be a pyrolysis product of polyvinyl chloride, styrene-acrylonitrile, acrylonitrile-butadiene-styrene, and polyacrylonitrile.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition of propane can produce acrid smoke and irritating fumes.

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**Section 6. Health Hazard Data**

**Carcinogenicity:** Neither the NTP, IARC, nor OSHA lists propane as a carcinogen.

**Summary of Risks:** This material is an asphyxiant. If sufficiently concentrated to reduce the oxygen level below 18% in inhaled air, symptoms such as rapid respiration, mental dullness, incoordination, poor judgement, and unconsciousness may result. If the oxygen concentration is reduced to 6% to 8% or less, unconsciousness leading to death occurs. Contact with liquified gas can produce frostbite and severe skin burns which may result in serious impairment.

**Medical Conditions Aggravated by Long-Term Exposure:** None reported.

**Target Organs:** Central nervous system.

**Primary Entry Routes:** Inhalation.

**Acute Effects:** Exposure to propane vapors can cause eye and respiratory tract irritation, headache, dizziness, and vomiting. At high concentrations, propane may have anesthetic properties. Direct contact with liquid propane can cause severe skin burns.

**Chronic Effects:** None reported.

**FIRST AID**

**Eyes:** Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.

**Skin:** Quickly remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.

**Inhalation:** Remove exposed person to fresh air and support breathing as needed. Emergency response personnel should be concerned with their own safety in oxygen-deficient areas. Use SCBA for rescue attempts in oxygen-deprived environments.

**Ingestion:** Ingestion is unlikely because of propane's physical properties. However, if liquid propane is ingested, severe cold injury to the mouth and oral cavity results. Monitor the airway, have trained medical personnel administer oxygen, and seek medical attention.

After first aid, get appropriate in-plant, paramedic, or community medical support.

**Physician's Note:** For frostbite, consider rapid rewarming at 108 °F/42 °C. Do not institute rewarming unless complete rewarming can be assured. A variety of pharmacologic agents to help restore perfusion to the tissues may be appropriate.

**Section 7. Spill, Leak, and Disposal Procedures**

**Spill/Leak:** Notify safety personnel, evacuate the hazard area, eliminate all heat and ignition sources, and supply maximum explosion-proof ventilation to keep the concentrations well below the lower flammability limit. Personnel involved in leak stoppage should use SCBAs and protect against direct contact with the liquified gas. Ventilate closed spaces before entering them. Follow applicable OSHA regulations (29 CFR 1910.120).

**Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**EPA Designations**

RCRA Hazardous Waste (40 CFR 261.33): Not listed

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

**Section 8. Special Protection Data**

**Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

**Respirator:** Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.

**Warning:** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Neoprene or polyurethane protective clothing is recommended.

**Ventilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2).

Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.<sup>(10)</sup>

**Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**Contaminated Equipment:** Never wear contact lenses in the work area; soft lenses may absorb, and all lenses concentrate, irritants. Remove the material from your shoes and equipment. Launder contaminated clothing before wearing.

**Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

**Section 9. Special Precautions and Comments**

**Storage Requirements:** Store and use propane cylinders and tanks in well-ventilated area, away from heat, direct sunlight, ignition sources, oxidizing agents, and cylinders of oxygen or chlorine. Follow standard procedures for handling cylinders and tanks of flammable, compressed gas. Provide protection against damaging cylinders and tanks. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded.

**Engineering Controls:** Avoid vapor inhalation and liquid contact with skin. Use only with adequate ventilation and appropriate personal protective gear. Propane is a serious fire and explosion hazard and should be handled accordingly. Do not expose to any heat or ignition source.

**Transportation Data (49 CFR 172.101, .102)**

DOT Shipping Name: Liquified petroleum gas

IMO Shipping Name: Propane

DOT Hazard Class: Flammable gas

IMO Hazard Class: 2.1

ID No.: UN1075

IMO Label: Flammable gas

DOT Label: Flammable gas

IMDG Packaging Group: —

DOT Packaging Requirements: 173.304, 173.314, 173.315

ID No.: UN1978

DOT Packaging Exceptions: 173.306

**MSDS Collection References:** 73, 84, 88, 100, 101, 103, 124, 126, 127, 132, 136, 138

**Prepared by:** MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

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AR307716



Curtin Matheson Scientific, Inc.  
9999 VETERANS MEMORIAL  
DOCK A  
HOUSTON, TX 77038

FISONS

# MATERIAL SAFETY DATA SHEET

JUL 19.

MAIL TO: BARR ENGINEERING CO  
ATTN: STEVE BOTTS  
7803 GLENROY ROAD

BLOOMINGTON, MN 55439--212

## SECTION 1 - NAME AND PRODUCT

5-02

### MANUFACTURER NAME AND ADDRESS

EM SCIENCE  
A DIV OF EM INDUSTRIES  
P.O. BOX 70  
GIBBSTOWN NJ 08027  
EMERGENCY PHONE 1-800-424-9300

CHEMICAL NUMBER: MSX0607H-1

ITEM NUMBER: 0401165

VNDR CATLG NBR:

ENTRY DATE: 02-24-90

CHANGE DATE: 02-27-90

### COMMON NAME (ON LABEL)

SODIUM HYDROXIDE SOLUTION, 1 N

### CHEMICAL FAMILY

CAUSTIC SOLUTION

### TRADE NAME & SYNONYMS

SODIUM HYDROXIDE SOLUTION, 1 N  
SODA LYE

### CHEMICAL FORMULA

NAOH (AQUEOUS SOLUTION)

## SECTION 2 - HAZARDOUS INGREDIENTS

HAZARDOUS COMPONENT	CAS	% (WT)	TLV	PEL
SODIUM HYDROXIDE SOLUTION 1N		100.00	.000 SEC.5	.000 SEC.5

PEL: Permissible Exposure Limit established by the Occupational Safety and Health Administration (OSHA).

TLV: Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists, 1986-87.

### OTHER INGREDIENT INFORMATION

NONE OTHER THAN SPECIFIED PRODUCT.

## SECTION 3 - PHYSICAL DATA

BOILING POINT	VOLATILE BY VOLUME (%)	VAPOR PRESSURE
N/A	N/A	N/A 20C
MELTING POINT	VAPOR DENSITY	SOLUBILITY IN WATER
N/A	N/A	SOLUBLE
EVAPORATION RATE ( = 1)	SPECIFIC GRAVITY	
N/A	N/A	

### APPEARANCE AND ODOR

CLEAR, COLORLESS LIQUID

### OTHER PHYSICAL DATA

MOLECULAR WEIGHT, SOLUTION

**SECTION 4 - FIRE AND EXPLOSION DATA****FLASH POINT**

NONCOMBUSTIBLE

**LOWER EXPLOSIVE LIMIT**

N/A

**UPPER EXPLOSIVE LIMIT**

N/A

**EXTINGUISHING MEDIA**EXTINGUISHING MEDIA..... ANY  
SUITABLE FOR ADJACENT MATERIAL.**UNUSUAL FIRE AND EXPLOSION HAZARDS**FIRE & EXPL. HAZARDS..... CAN REACT  
WITH CERTAIN METALS (AL, ZN, SN) TO RELEASE EXPLOSIVE HYDROGEN GAS.**SPECIAL FIRE FIGHTING PROCEDURES**FIRE FIGHTING PROC..... WEAR  
SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING.**SECTION 5 - HEALTH HAZARD DATA****HEALTH HAZARDS (ACUTE & CHRONIC)**  
SEE SIGNS AND SYMPTOMS OF EXPOSURE.**PRIMARY ROUTES OF EXPOSURE**

ROUTES OF ENTRY..... INHALATION, INGESTION

**SIGNS AND SYMPTOMS OF EXPOSURE**SYMPTOMS OF EXPOSURE ..... CONTACT  
WITH EYES CAUSES BURNS. CAUSES IRRITATION OR BURNS ON  
CONTACT WITH SKIN. HARMFUL IF SWALLOWED.

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## SECTION 5 - HEALTH HAZARD DATA (CONTINUED)

**MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE**  
 MEDICAL COND. AGGRAVATED BY EXP: DATA NOT AVAILABLE.

### CARCINOGENICITY

INDICATORS NOT GIVEN

NTP ☐ Yes ☐ No

IARC ☐ Yes ☐ No

OSHA ☐ Yes ☐ No

CARCINOGENICITY.....THE

MATERIAL IS NOT LISTED AS A CANCER CAUSING AGENT.

### EMERGENCY AND FIRST AID PROCEDURES

EMERGENCY FIRST AID.....GET

MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE SKIN: IMMEDIATELY FLUSH THOROUGHLY WITH LARGE AMOUNTS OF WATER EYES: IMMEDIATELY FLUSH THOROUGHLY WITH WATER FOR AT LEAST 15 MINUTES INHALATION: REMOVE TO FRESH AIR; GIVE ARTIFICIAL RESPIRATION IF BREATHING HAS STOPPED INGESTION: DO NOT INDUCE VOMITING; GET IMMEDIATE MEDICAL ATTENTION REMOVE CONTAMINATED CLOTHING AND WASH BEFORE REUSE.

### THRESHOLD LIMITS / TOXICITY DATA

ACGIH TLV/OSHA PEL (TWA)..... 2 MG/CU.M. CL TOXICITY DATA..... ORL-RBT LDLO: 500 MG/KG

## SECTION 6 - REACTIVITY DATA

**STABILITY** Unstable ☐ Stable ☒

**CONDITIONS TO AVOID**

CONDITIONS TO AVOID ..... HEAT

### INCOMPATIBILITY (MATERIALS TO AVOID)

MATERIALS TO AVOID..... ( ) WATER (X) ACIDS ( ) BASES ( ) CORROSIVES ( ) OXIDIZERS (X) OTHER: METALS, ORGANIC HALOGENS, NITRO COMPOUNDS, AL, SN, ZN.

SECTION 6 - REACTIVITY DATA (CONTINUED)

HAZARDOUS DECOMPOSITION OR BYPRODUCTS  
HAZARDOUS DECOMPOSITION... NONE INDICATED

HAZARDOUS POLYMERIZATION May Occur ☐ Will Not Occur ☐  
CONDITIONS TO AVOID  
HAZARDOUS POLYMERIZATION: DOES NOT OCCUR

SECTION 7 - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED  
SPILL RESPONSE -DIKE  
SPILL: TAKE UP WITH ABSORBENT; CONTAINERIZE FOR PROPER DISPOSAL

WASTE DISPOSAL METHOD  
WASTE DISPOSAL TO BE PERFORMED IN COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND  
FEDERAL REGULATIONS.

SECTION 8 - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION  
VENTILATION, RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, EYE PROTECTION: MATERIAL  
SHOULD BE HANDLED OR TRANSFERRED IN AN APPROVED FUME HOOD OR WITH ADEQUATE  
VENTILATION PROTECTIVE GLOVES (NEOPRENE OR EQUIVALENT) MUST BE  
WORN TO PREVENT SKIN CONTACT. PROTECTIVE CLOTHING (IMPERVIOUS) SHOULD BE WORN  
WHEN HANDLING THIS MATERIAL SAFETY  
GLASSES WITH SIDE SHIELDS MUST BE WORN AT ALL TIMES

LOCAL VENTILATION

SEE SECTION 8 - RESPIRATORY PROTECTION

MECHANICAL VENTILATION

SEE SECTION 8 - RESPIRATORY PROTECTION

SPECIAL VENTILATION

SEE SECTION 8 - RESPIRATORY PROTECTION

## SECTION 8 - SPECIAL PROTECTION INFORMATION (CONTINUED)

### OTHER VENTILATION

SEE SECTION 8 - RESPIRATORY PROTECTION

### PROTECTIVE GLOVES

SEE SECTION 8 - RESPIRATORY PROTECTION

### EYE PROTECTION

SEE SECTION 8 - RESPIRATORY PROTECTION

### OTHER PROTECTIVE CLOTHING OR EQUIPMENT

SEE SECTION 8 - RESPIRATORY PROTECTION

## SECTION 9 - SPECIAL PRECAUTIONS

### PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

HANDLING & STORAGE - STORE IN

COOL, DRY AREA AWAY FROM ACIDS AND METALS DO NOT BREATHE SOLUTION MIST

DO NOT GET IN EYES, ON SKIN OR ON CLOTHING

KEEP CONTAINER CLOSED.

WORK/HYGIENIC PRACTICES: WASH THOROUGHLY AFTER HANDLING. DO NOT TAKE INTERNALLY. EYE WASH AND SAFETY EQUIPMENT SHOULD BE READILY AVAILABLE.

## SECTION 10 - OTHER INFORMATION

### MISCELLANEOUS INFO.

PREPARATION DATE JUN 1, '89 INFORMATION PHONE

NUMBER : (609) 354-9200

HEALTH : 3 FLAMMABILITY : 0

REACTIVITY : 0 SPECIAL HAZARDS:

DOT SHIPPING NAME: SODIUM HYDROXIDE, SOLUTION, DOT

NUMBER: UN1824 COMMENTS: NONE

N/A - NOT AVAILABLE.



**AIR LIQUIDE**

## Material Safety Data Sheet

(These data are prepared for product supplied in DOT 39 nonreusable cylinders.)

AIR LIQUIDE AMERICA CORPORATION P.O. BOX 3047 HOUSTON, TX 77253-3047	PRODUCT NAME	5-100 PPM Sulfur Dioxide in Nitrogen	CAS NUMBER SO <sub>2</sub> = 7446-09-5 N <sub>2</sub> = 7727-37-9
	TELEPHONE (510) 977-8500 EMERGENCY RESPONSE INFORMATION ON PAGE 2		
	TRADE NAME AND SYNONYMS	5-100 PPM Sulfur Dioxide in Nitrogen	NFPA 704 NUMBER (HFR)
ISSUE DATE	JANUARY 1, 1992	CHEMICAL NAME AND SYNONYMS	1 0 0
AND REVISIONS	CORPORATE SAFETY DEPT.	See Page 4	
FORMULA	MOLECULAR WEIGHT	CHEMICAL FAMILY	
See Page 4	See Page 4	Gas Mixture	

### HEALTH HAZARD DATA

#### TIME WEIGHTED AVERAGE EXPOSURE LIMIT

Sulfur Dioxide TWA = 2 Molar PPM; STEL = 5 Molar PPM (ACGIH 1991-1992 and OSHA 1989).  
Nitrogen is a simple asphyxiant. (Continued on Page 4)

#### SYMPTOMS OF EXPOSURE

Effects of exposure to high concentrations so as to displace the oxygen in the air necessary for life are headache, dizziness, labored breathing and eventual unconsciousness.

#### TOXICOLOGICAL PROPERTIES

These mixtures are nontoxic but the liberation of a large amount in a confined area could displace the amount of oxygen in air necessary to support life.

Persons in ill health where such illness would be aggravated by exposure to these mixtures should not be allowed to work with or handle these products.

Neither sulfur dioxide or nitrogen are listed in the IARC, NTP or by OSHA as a carcinogen or a potential carcinogen.

Listed as Carcinogen  
or Potential Carcinogen

National Toxicology  
Program

Yes ☐  
No ☒

I.A.R.C.  
Monographs

Yes ☐  
No ☒

OSHA

Yes ☐  
No ☒

#### RECOMMENDED FIRST AID TREATMENT

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO THESE MIXTURES. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

**Inhalation:** Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted respiration and supplemental oxygen. Further treatment should be symptomatic and supportive.

Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Air Liquide America Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or consequences of its use. Since Air Liquide America Corporation has no control over the use of this product, it assumes no liability for damage or loss of product resulting from proper (or improper) use or application of the product. Data Sheets may be changed from time to time. Be sure to consult the latest edition.

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## HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

None

## PHYSICAL DATA

BOILING POINT	SO <sub>2</sub> = 13.9°F (-10.1°C) N <sub>2</sub> = -320.5°F (-195.8°C)	LIQUID DENSITY AT BOILING POINT See Page 4
VAPOR PRESSURE	See Page 4	GAS DENSITY AT 70°F 1 atm .0725 lb/ft <sup>3</sup> (1.161 kg/m <sup>3</sup> )
SOLUBILITY IN WATER	SO <sub>2</sub> = Soluble N <sub>2</sub> = Negligible	FREEZING POINT SO <sub>2</sub> = -103.9°F (-75.52°C) N <sub>2</sub> = -345.9°F (-209.9°C)
APPEARANCE AND ODOR	Colorless gas with slight acidic odor. Specific Gravity (Air=1) @ 70°F (21.1°C) = 0.97	

## FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED) N/A	AUTO IGNITION TEMPERATURE N/A	FLAMMABLE LIMITS % BY VOLUME N/A
EXTINGUISHING MEDIA Nonflammable gas mixtures	ELECTRICAL CLASSIFICATION Nonhazardous	
SPECIAL FIRE FIGHTING PROCEDURES  If cylinders are involved in a fire, safely relocate or keep cool with water spray.		
UNUSUAL FIRE AND EXPLOSION HAZARDS  None		

## REACTIVITY DATA

STABILITY Unstable		CONDITIONS TO AVOID
Stable	X	N/A
INCOMPATIBILITY (Materials to avoid)	None	
HAZARDOUS DECOMPOSITION PRODUCTS	None	
HAZARDOUS POLYMERIZATION May Occur		CONDITIONS TO AVOID
Will Not Occur	X	N/A

## SPILL OR LEAK PROCEDURES

## STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in container or container valve, contact the closest Liquid Air Corporation location.

## WASTE DISPOSAL METHOD

Do not attempt to dispose of waste or unused quantities. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured to Liquid Air Corporation for proper disposal. For emergency disposal, contact the closest Liquid Air Corporation location.

## EMERGENCY RESPONSE INFORMATION

IN CASE OF EMERGENCY INVOLVING THIS MATERIAL, CALL DAY OR NIGHT (800) 231-1366

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AT (800) 424-9300

<b>RESPIRATORY PROTECTION (Specify type)</b>		Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.	
<b>VENTILATION</b>	<b>LOCAL EXHAUST</b>	See Page 4	<b>SPECIAL</b>
	<b>MECHANICAL (Gen.)</b>	N/A	<b>OTHER</b>
See Local Exhaust			N/A
<b>PROTECTIVE GLOVES</b>		Any material	
<b>EYE PROTECTION</b>		Safety goggles or glasses	
<b>OTHER PROTECTIVE EQUIPMENT</b>		Safety shoes	

**SPECIAL PRECAUTIONS\***

<b>SPECIAL LABELING INFORMATION</b>	
DOT Shipping Name: Compressed Gases, N.O.S.	DOT Hazard Class: Division 2.2
DOT Shipping Label: Nonflammable Gas	DOT I.D. No.: UN 1956
<b>SPECIAL HANDLING RECOMMENDATIONS</b>	
<p>Use only in well ventilated areas. Use a pressure reducing regulator when connecting cylinder to lower pressure (&lt;500 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Close valve after each use and when empty.</p> <p>For additional handling recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.</p>	
<b>SPECIAL STORAGE RECOMMENDATIONS</b>	
<p>Protect cylinders from physical damage. Store in cool, dry, well ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 125F (52C). Full and empty cylinders should be segregated. Use a "first in - first out" inventory system to prevent full cylinders being stored for excessive periods of time.</p> <p>For additional storage recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.</p>	
<b>SPECIAL PACKAGING RECOMMENDATIONS</b>	
<p>These mixtures are noncorrosive and may be used with all materials of construction.</p>	
<b>OTHER RECOMMENDATIONS OR PRECAUTIONS</b>	
<p>DOT 39 cylinders may not be reused or refilled (49CFR).</p> <p>NEVER transport these cylinders in trunks of vehicles, enclosed vans, truck cabs or in passenger compartments. Transport them "contained" in open flatbed or open pick-up type vehicles.</p> <p>Reporting under SARA, Title III, Section 313 not required.</p>	

\*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which may not be contained herein. The customer or user of this product should be familiar with these regulations.

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**AIR LIQUIDE**
ADDITIONAL DATA
CHEMICAL NAME AND SYNONYMS: 5-100 Molar PPM Sulfur Dioxide in Nitrogen

FORMULA: 5-100 Molar PPM SO<sub>2</sub> in N<sub>2</sub>
MOLECULAR WEIGHT: SO<sub>2</sub> = 64.06  
N<sub>2</sub> = 28.01

HEALTH HAZARD DATA
TIME WEIGHTED AVERAGE EXPOSURE LIMIT: (Continued)

Oxygen levels should be maintained at greater than 18 molar % at normal atmospheric pressure (pO<sub>2</sub> > 135 torr). OSHA 1989 does not list a TWA for nitrogen.

PHYSICAL DATA
LIQUID DENSITY AT BOILING POINT: SO<sub>2</sub> = 89.3 lb/ft<sup>3</sup> (1430 kg/m<sup>3</sup>)  
N<sub>2</sub> = 50.46 lb/ft<sup>3</sup> (808.3 kg/m<sup>3</sup>)

VAPOR PRESSURE @ 70°F (21.1°C): SO<sub>2</sub> = 49.3 psia (340 kPa)  
N<sub>2</sub> = Above the critical temperature

SPECIAL PROTECTION INFORMATION
LOCAL EXHAUST:

To prevent accumulation of high concentrations so as to reduce the oxygen level in the air to less than 18 molar percent.

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\*\*SULFURIC ACID\*\*  
\*\*SULFURIC ACID\*\*  
\*\*SULFURIC ACID\*\*

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC  
CHEMICAL DIVISION  
1 REAGENT LANE  
FAIR LAWN NJ 07410  
(201) 796-7100  
EMERGENCY NUMBER: (201) 796-7100  
CHEMREC ASSISTANCE (800) 424-9300

THIS INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST OF  
OUR KNOWLEDGE AT THE TIME OF PREPARATION. IT IS NOT A WARRANTY, EXPRESS OR IMPLIED, IN RESPECT TO  
SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS  
SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE  
INFORMATION FOR THEIR PARTICULAR PURPOSES.

SUBSTANCE IDENTIFICATION

CAS-NUMBER 7664-93-9

SUBSTANCE: \*\*SULFURIC ACID\*\*

TRADE NAMES/SYNONYMS:  
OIL OF VITRIOL; ROY; DIPPING ACID; VITRIOL BROWN OIL; HYDROGEN SULFATE;  
HYDROGEN SULFATE; SULFURIC ACID; SULFURIC ACID; SULFURIC ACID;  
HYDROGEN SULFATE; SULFURIC ACID; SULFURIC ACID; SULFURIC ACID;  
A-298; A-510; A-468; 50-A-172; 50-A-174; ACC2230.

CHEMICAL FAMILY:  
INORGANIC ACID

MOLECULAR FORMULA: H<sub>2</sub>SO<sub>4</sub>

MOLECULAR WEIGHT: 98.07

CERCLA RATINGS (SCALE 0-3): HEALTH-3 FIRE-0 REACTIVITY-2 PERSISTENCE-0  
HFA RATINGS (SCALE 0-4): HEALTH-3 FIRE-0 REACTIVITY-2 PERSISTENCE-0

COMPONENTS AND CONTAMINANTS

COMPONENT: SULFURIC ACID

PERCENT: 98

COMPONENT: WATER

PERCENT: 2

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:

SULFURIC ACID:  
1 MG/M<sup>3</sup> OSHA TWA  
1 MG/M<sup>3</sup> ACGIH TWA  
1 MG/M<sup>3</sup> NIOSH RECOMMENDED 10 HOUR TWA

1000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY

1000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY

1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: ODORLESS, CLEAR, COLORLESS, DENSE HYGROSCOPIC OILY LIQUID WITH

A MARKED ACID TASTE WHEN PURE. BOILING POINT: 559 F (290 C)

MELTING POINT: 50 F (10 C) SPECIFIC GRAVITY: 1.84

VAPOR PRESSURE: <0.001 @ 20 C PH: <3 SOLUBILITY IN WATER: SOLUBLE

ODOR THRESHOLD: >1 MG/M<sup>3</sup> (EST) VAPOR DENSITY: 3.4

SOLVENT SOLUBILITY: DECOMPOSES IN ETHYL ALCOHOL

Q 340 C IT DECOMPOSES INTO SULFUR TRIOXIDE AND WATER

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:  
NEGLECTIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR  
OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER.  
CONTACT WITH EASILY OXIDIZABLE ORGANIC, OR OTHER COMBUSTIBLE MATERIALS  
MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

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FIRE FIGHTING MEDIUM  
ANY CHEMICAL OR CARBON DIOXIDE  
11390 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5100.51.  
FOR LARGER FIRES, FLOOD AREA WITH WATER FROM A DISTANCE  
11390 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5100.51.  
FIRE FIGHTING  
DO NOT GET WATER INSIDE CONTAINER. DO NOT GET SOLID STREAM OF WATER ON  
SPILLED MATERIAL. MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO SO WITHOUT RISK.  
IF YOU CANNOT MOVE CONTAINER, COVER IT WITH A WET RAG OR WET TOWEL.  
WET RAGS AND TOWELS SHOULD BE KEPT AWAY FROM ENDS OF TANKS (11390 EMERGENCY RESPONSE  
GUIDEBOOK, DOT P 5100.51 GUIDE PAGE 391).  
USE AGENT SUITABLE FOR TYPE OF FIRE. USE FLOODING AMOUNTS OF WATER AS A FOG.  
COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER. APPLY FROM AS FAR A DISTANCE  
AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS, KEEP UPWIND.

TRANSPORTATION DATA  
DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.1011  
CORROSIVE MATERIAL  
DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND  
SUBSECTION C  
CORROSIVE  
DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.272  
EXCEPTIONS: 49 CFR 173.244

TOXICITY  
SULFURIC ACID:  
IRRITATION DATA: 1360 UO EYE-RABBIT SEVERE; 5 MG/30 SECONDS RINSED EYE-RABBIT  
SEVERE.  
TOXICITY DATA: 3 MG/M3/24 HOURS INHALATION-HUMAN 10101, 510 MG/M3/32 HOURS  
INHALATION-HUMAN 10101, 200 MG/M3/24 HOURS INHALATION-HOUSE L501, 18 MG/M3  
INHALATION-GUIPMA P10 L501, 2140 MG/M3 ORAL-RAI L501, 135 MG/KG  
UNREPORTED-MAN LDLO; REPRODUCTIVE EFFECTS DATA (RTECS): TUMORIGENIC DATA  
LAJEPAS 120131, 358, 841.  
CARCINOGEN STATUS: NONE.  
LOCAL EFFECTS: CORROSIVE.  
ACUTE TOXICITY LEVEL: HIGHLY TOXIC BY INHALATION; MODERATELY TOXIC BY  
INGESTION.  
TARGET EFFECTS: POISONING MAY AFFECT THE BODY'S PH BALANCE AND IN TURN AFFECT  
THE NERVOUS SYSTEM.

HEALTH EFFECTS AND FIRST AID  
INHALATION:  
SULFURIC ACID:  
CORROSIVE/HIGHLY TOXIC. 80 MG/M3 IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.  
ACUTE EXPOSURE- INHALATION OF MISTS MAY CAUSE MUCOUS MEMBRANE IRRITATION.  
PRINCIPALLY AFFECTING THE RESPIRATORY TRACT EPITHELIUM. LOW  
CONCENTRATIONS, 0.35-5 MG/M3, MAY CAUSE INCREASED PULMONARY AIR FLOW  
RESISTANCE AND SUBSEQUENTLY CAUSE RATHER AND OF CONSIDERABLE POSSIBLE  
DAMAGE TO LUNG TISSUE. VAPORS MAY CAUSE NASAL SECRETIONS, SNEEZING, A  
BURNING OR TICKLING SENSATION IN THE NOSE AND THROAT AND RETROSTERNAL  
REGION, FOLLOWED BY COUGH, RESPIRATORY DISTRESS, TRACHEOBRONCHITIS,  
CHEMICAL PNEUMONITIS AND POSSIBLE SPASM OF THE VOCAL CORDS. HIGH  
CONCENTRATIONS MAY PRODUCE BLOODY NASAL SECRETIONS AND PULMONARY EDEMA. TENATEMESIS  
GASTRITIS, TRACHEOBRONCHITIS AND PULMONARY EDEMA. INDIVIDUAL SPRAYED  
IN THE FACE WITH SULFURIC ACID LIQUID EXPERIENCED DELAYED SYMPTOMS OF  
PULMONARY FIBROSIS, RESIDUAL BRONCHITIS, AND PULMONARY EMPHYSEMA.  
VAPORS FROM DILUTE SOLUTIONS MAY IRRITATE MUCOUS MEMBRANES.  
CHRONIC EXPOSURE- REPEATED EXPOSURE TO THE MIST MAY CAUSE INFLAMMATION  
OF THE UPPER RESPIRATORY TRACT, CHRONIC BRONCHITIS AND SICKING OF THE  
DENTAL ENAMEL. THE CENTRAL AND LATERAL INCISORS ARE MOST AFFECTED.  
REPEATED EXCESSIVE EXPOSURE OVER LONG PERIODS OF TIME HAVE RESULTED IN

PHARMACOLOGICAL STUDIES: INHIBITION OF THE URINARY RESPIRATORY TRACT IRRITATIONS.  
PHARMACOLOGICAL STUDIES: INHIBITION OF THE URINARY RESPIRATORY TRACT IRRITATIONS.  
MAY CAUSE A TEMPERE DEFECT OF THE RESPIRATORY TRACT IRRITATIONS WHICH  
AFFECTS THE MECHANISM SYSTEM AND PRODUCES AGITATION, INSTABILITY AND  
GENERALIZED WEAKNESS. AN EPIDEMIOLOGICAL STUDY OF WORKERS AT A REFINERY  
AND CHEMICAL PLANT SUGGESTS AN INCREASED RISK OF LARYNGEAL CANCER  
FROM EXPOSURE TO HIGH CONCENTRATIONS OF SULFURIC ACID. REPRODUCTIVE  
EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING  
HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD  
PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND  
AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN  
SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION  
IMMEDIATELY.

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ACETIC ANHYDRIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
ACETONE + NITRIC ACID: VIOLENT DECOMPOSITION.  
ACETONE + POTASSIUM DICROMATE: IGNITION.  
ACETONE CYANURIC: PRESSURE INCREASE, WITH POSSIBLE EXPLOSIVE RUPTURE OF VESSEL.  
ACETONITRILE: VIOLENT EXOTHERM ON HEATING; Sulfur trioxide reduces initiation temperature.  
ACETONOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
ACROLEIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
ACRYLONITRILE: VICINOUS EXOTHERMIC POLYMERIZATION.

SKIN CONTACT WITH SULFURIC ACID COMPOSITIVE  
ACUTE EXPOSURE TO CONTACT WITH CONCENTRATED SULFURIC ACID MAY CAUSE SEVERE SECOND AND THIRD DEGREE SKIN BURNS WITH NECROSIS DUE TO ITS AFFINITY FOR WATER AND SUBSEQUENT SEVERE DEHYDRATING ACTION, AND ITS EXOTHERMIC REACTION WITH MOISTURE. POSSIBLE CHARRING MAY OCCUR LEADING TO SLOTTING AND COLLAPSE DEPENDING ON THE AMOUNT OF TISSUE INVOLVED. THE RESULTING WOUNDS MAY BE LONG IN HEALING AND MAY CAUSE EXTENSIVE SCARRING. THAT MAY RESULT IN FUNCTIONAL IMPAIRMENT. CONTACT WITH DILUTE SOLUTIONS MAY CAUSE SKIN IRRITATION. CONTACT WITH LOW CONCENTRATIONS MAY CAUSE CHEMICAL DEGRADATION AND DISCOLORATION OF THE HANDS AND GARBAGE. CHRONIC PURULENT INFLAMMATION AROUND THE NAILS (REPEATED CONTACT WITH DILUTE SOLUTIONS) MAY CAUSE DERMATITIS.

1. FIRST AID - REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

HAVE CONTACT WITH SULFURIC ACID;  
 CORROSIVE.  
 ACUTE EXPOSURE - EXPOSURE TO THE VAPORS MAY CAUSE A BURNING OR STINGING SENSATION IN THE EYES WITH LACRIMATION, BLURRED VISION AND CONJUNCTIVAL IRRITATION. REPEATED CONJUNCTIVITIS AND A PEARLY OPACIFICATION OF THE CORNEA MAY OCCUR. SEVERE CORNEAL DAMAGE AND BLINDNESS AS WELL AS SCARRING OF THE EYELIDS MAY OCCUR. SEVERE SULFURIC ACID BURNS HAVE INCLUDED GLAUCOMA AND CATARACT AS COMPLICATIONS IN THE MOST SEVERE CASES. CONTACT WITH DILUTED ACID MAY PRODUCE MORE TRANSIENT EFFECTS FROM WHICH RECOVERY MAY BE EXPECTED. REPEATED EXPOSURE MAY RESULT IN LACRIMATION AND CHRONIC CONJUNCTIVITIS.

FIRST AID - WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER. OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INDIGESTION, SULFURIC ACID: CHRONIC EXPOSURE-ACUTE EXPOSURE- INGESTION MAY CAUSE BURNING PAIN IN THE MOUTH, THROAT, ESOPHAGUS AND AROUND A SOUR TASTE AND NAUSEA, FOLLOWED BY VOMITING AND DIARRHEA OF CHARRIE BLACK OCCULT BLOOD CONTENTS, DYSPEPSIA, ANOREXIA, GROWING OR YELLOWISH STAINS MAY BE FOUND AROUND THE MOUTH, INTENSE THIRST, OFFICUT SWALLOWING, ACIDEMIA, STOMATITIS, RAPID AND WEAK PULSE, SHALLOW BREATHING, SHOCK AND POSSIBLE CONVULSIONS MAY OCCUR. ALBUMIN, BLOOD AND CASTS IN URINE, ANURIA, ESOPHAGEAL AND DELAYED STENOSIS HAS BEEN REPORTED. POSSIBLE PERFORATION OF THE GASTROINTESTINAL TRACT. CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID: DO NOT USE GASTRIC LAVAGE OR EMESIS. DILUTE THE ACID IMMEDIATELY BY DRINKING LARGE QUANTITIES OF WATER OR MILK. IF VOMITING PERSISTS, ADMINISTER FLUIDS REPEATEDLY. INGESTED ACID MUST BE DILUTED APPROXIMATELY 100 FOLD TO RENDER IT HARMLESS TO TISSUES. MAINTAIN AIRWAY AND TREAT SHOCK (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION.

ANTIOXYCANT  
NO SPECIFIC ANTIOXYCANT. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:





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POTASSIUM: EXPLOSIVE INTERACTION.  
POTASSIUM TERT-BUTOXIDE: IGNITION.  
POTASSIUM CHLORATE: POSSIBLE FIRE AND EXPLOSION.  
POTASSIUM PERMANGANATE: POSSIBLE EXPLOSION IN THE PRESENCE OF MOISTURE.  
POTASSIUM PERMANGANATE + POTASSIUM CHLORIDE: VIOLENT EXPLOSION.  
PROPYLACETONE (BETA): TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
2-PYRIDINE METHANOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
PYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
REDUCING AGENTS: REACTS.

RUBBER: ATTACKED.  
RUBIDIUM ACETYLIDE: IGNITION ON CONTACT.  
SILVER PERMANGANATE (MOIST): EXPLOSIVE REACTION.  
SILVER PEROCHROMATE: EXPLOSIVE REACTION.  
SILVER PEROCHROMATE: VIOLENT REACTION.  
SODIUM CARBONATE: VIOLENT REACTION.  
SODIUM CHLORIDE: POSSIBLE FIRE OR EXPLOSION.  
SODIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
SODIUM TETRAHYDROBORATE: VIOLENT, EXOTHERMIC REACTION.  
SODIUM TETRAHYDROBORATE: VIOLENT, EXOTHERMIC REACTION.  
STEELE: POSSIBLE EXPLOSION DUE TO FOSPHOR GAS FROM THE ALUMINUM REACTION.  
TETRAHYDROBORATE: VIOLENT REACTION IN CLOSED CONTAINERS.  
1, 2, 4, 5-TETRAZINE: VIOLENT DECOMPOSITION ON CONTACT.  
THALLIUM I: AZIDITHIOCARBONATE: MAY EXPLODE ON CONTACT.

1, 3, 5-TRINITROBENZENE: VIOLENT DECOMPOSITION ON CONTACT.  
1, 3, 5-TRINITROBENZENE: VIOLENT DECOMPOSITION ON CONTACT.  
VIOLENT: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.  
ZINC CHLORIDE: LIKELY TO CAUSE FIRES AND EXPLOSIONS.  
ZINC IODIDE: VIOLENT INTERACTION.

DECOMPOSITION:  
THERMAL DECOMPOSITION MAY RELEASE TOXIC OXIDES OF SULFUR.

POLYMERIZATION:  
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

#### STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

#### \*\*STORAGE\*\*

PROTECT AGAINST PHYSICAL DAMAGE AND WATER. SEPARATE FROM CARBIDES, CHLORATES, FULMINATES, NITRATES, PICRATES, POWDERED METALS, AND COMBUSTIBLE MATERIALS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

HAZARDOUS PLANNING QUANTITY (LBS):  
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

#### \*\*DISPOSAL\*\*

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D002.  
100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

#### CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). VIOLENT REACTION WITH WATER. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN CONFINED SPACES. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

#### SPILL AND LEAK PROCEDURES

SOIL SPILL:  
DIG/ISOLATING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.  
DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.  
USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.  
NEUTRALIZE SPILL WITH SLAKED LIME, SODIUM BICARBONATE OR CRUSHED LIMESTONE.

AR307730

## EMERGENCY WASH FACILITIES:

[illegible]

## PROTECTIVE EQUIPMENT

RESPIRATOR) THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POKET GUIDE TO CHEMICAL HAZARDS, NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.

THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND

1. ANY POWERED AIR-PURIFYING RESPIRATOR WITH AN ACID GAS CARTRIDGE(S) AND HAVING A HIGH-EFFICIENCY PARTICULATE FILTER.

2. ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

160 MG/M3 - ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND ACID GAS CARTRIDGE(S), IN COMBINATION WITH A HIGH-EFFICIENCY PARTICULATE FILTER.

161 ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

162 ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

163 ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (OAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ACID GAS CANISTER HAVING A HIGH-EFFICIENCY PARTICULATE FILTER.

DO NOT/M3 - ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ACID GAS CANISTER HAVING A HIGH-EFFICIENCY PARTICULATE FILTER.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS;  
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

ANY SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN  
AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND  
OR OTHER POSITIVE PRESSURE MODE.

—

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DATE: 05/11/91 ACCT: 061660-01 PO NBR: VERBAL 05-08-91  
INDEX: 0591281016 CAT NO: A300500

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WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH, FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED: FISHER SCIENTIFIC, INC. REVISION DATE: 12/06/90  
CREATION DATE: 11/28/84

ADDITIONAL INFORMATION:  
THIS INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, WE MAKE NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO THE INFORMATION. EMPLOYERS ARE RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE INFORMATION FOR THEIR PARTICULAR PURPOSES.

AR307732



# Material Safety Data Sheet

June 20, 1994

**YSI, Incorporated**  
1725 Brannum Lane  
Yellow Springs, OH 45387  
USA

Information and Emergency Phone: 1-800-765-4974

## SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME: YSI 3682 Zobel Solution

FORMULA: n/ap

Chemical Type: Inorganic chloride / cyanide

CAS No. n/app

## SECTION 2 - HAZARDOUS / IMPORTANT INGREDIENTS

Chemical	CAS No.	PERCENT	PEL/TLV	CARCINOGEN (OSHA, NTP, IARC)
Potassium chloride	7447-40-7	72 - 78%	none	no
Potassium ferrocyanide, trihydrate	14459-95-1	10 - 15%	none	no
Potassium ferricyanide	13746-66-2	10 - 15%	none	no

## SECTION 3 - CHEMICAL AND PHYSICAL PROPERTIES

Appearance: white powder	Boiling Point: n/av
Odor: none	Melting Point: n/av
pH: neutral	Specific Gravity: n/av
Water Solubility: infinite	Vapor Pressure: n/ap
Evaporation Rate: n/av	Vapor Density: n/ap

## SECTION 4 - FIRE AND EXPLOSION HAZARDS

Flash Point: none Explosive Limits: none

Extinguishing Media: n/ap

Special Firefighting Procedures and Hazards: Material is not combustible. May emit toxic fumes when heated, such as NOx, HCN, HCl. Wear protection as described in Section 6.

## SECTION 5 - REACTIVITY INFORMATION

Stable: ☒ Unstable: ☐ Precautions: none known

Hazardous Polymerization: Occurs: ☐ Does Not Occur: ☒

Incompatibility: strong acids and oxidizing agents.

Hazardous Decomposition Products: When heated, possibly NOx, HCN, HCl.

YSI 3682 June 20, 1994

**SECTION 6 - HEALTH HAZARDS / PROTECTIVE MEASURES / FIRST AID**Inhalation:

Possible irritation from dusts. (see CHRONIC below)

Use a NIOSH approved respirator for dusts. Get supplier recommendations. Provide adequate ventilation.

Minimize dusty conditions.

Remove to fresh air and provide artificial respiration if needed.

Skin:

Possible irritation from dusts. (see CHRONIC below)

Wear dust-proof gloves and other body protection as needed. Minimize dusty conditions.

Wash exposed areas with soap and water for 15 minutes. Remove contaminated clothing, and wash before re-using.

Eyes:

Possible irritation from dust.

Wear dust barrier goggles. Eliminate dusty conditions.

Flush with water for 15 minutes.

Ingestion

No effects expected from normal use and minor amounts ingested. Large amounts, over 1 tablespoon, can cause digestive system upset s. (see CHRONIC below)

Reduce dusting. Avoid mouth breathing. Use face mask. Provide adequate ventilation.

Avoid swallowing. Spit out.. Drink large amounts of water. Induce vomiting if person is conscious. Otherwise, and if effects persist, get medical attention.

**CHRONIC EFFECTS:** None reported for this material. "Cyanides" in general are often reported as toxic to humans. Therefore, it is recommended that exposure via skin, inhalation, and ingestion be limited.

**IN ALL CASES: GET MEDICAL ATTENTION IF EFFECTS PERSIST.**

Most likely routes of entry: skin, eyes, ingestion.

**SECTION 7 - PRECAUTIONS FOR SAFE HANDLING AND USE**

Spills and Leaks: Take up powder in any container, and hold for disposal. Flush residual to sewer or ground. Provide personal protection as described in Section 6.

Storage and Handling: Keep containers closed, Discard any material that may be contaminated. Minimize dusting.

Waste Disposal: Is not listed as RCRA hazardous waste at this date. Cyanides are restricted in water disposed to streams and to sewers. Therefore, landfill disposal is indicated; check with local disposal companies.

Empty Containers: Rinse well. Disposal as appropriate for glass and plastic containers.

**SECTION 8 - REGULATORY INFORMATION**

**DOT:** Not regulated.,  
**SARA Title III, S.313, Form R:** Nothing reportable.

The information contained herein is based on data available at this time and is believed to be accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Since information contained herein may be applied under conditions beyond our control, and with which we may be unfamiliar, no responsibility is assumed for the results of its use. The person receiving this information shall make his own determination of the suitability of the material for his particular use.



# Material Safety Data Sheet

June 20, 1994

YSI, Incorporated  
1725 Brannum Lane  
Yellow Springs, OH 45387  
USA

09-390-21

Information and Emergency Phone: 1-800-765-4974

## SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME: YSI 3167 Conductivity Callibrator 1,000 micromho/cm

FORMULA: n/ap

Chemical Type: Dilute water solution of the listed ingredients.

CAS No. n/ap

## SECTION 2 - HAZARDOUS / IMPORTANT INGREDIENTS

Chemical / Synonym	CAS No.	PERCENT	PEL/TLV	CARCINOGEN (OSHA, NTP, IARC)
Potassium Chloride	7447-40-7	<1.0%	none	no
Iodine, crystal, resublimed	7553-56-2	<1.0%	0.1 ppm (Ceiling)	no
Water (balance)				

## SECTION 3 - CHEMICAL AND PHYSICAL PROPERTIES

Appearance: clear bluish tinted liquid

Boiling Point: 212°F (100°C)

Odor: slt. acrid

Melting Point: 32°F (0°C)

pH: neutral

Specific Gravity: 1.00

Water Solubility: infinite

Vapor Pressure: = water

Evaporation Rate: = water

Vapor Density: = water vapor

## SECTION 4 - FIRE AND EXPLOSION HAZARDS

Flash Point: none

Explosive Limits: none

Extinguishing Media: n/ap

Material is basically water, and is not combustible nor does it emit flammable vapors.

## SECTION 5 - REACTIVITY INFORMATION

Stable: X Unstable: Precautions: none

Hazardous Polymerization: Occurs: Does Not Occur: X

Incompatibility: Extensive contact may cause reaction with aluminum, steel, zinc, magnesium.

Hazardous Decomposition Products: none from water solution

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**SECTION 6 - HEALTH HAZARDS / PROTECTIVE MEASURES / FIRST AID**Inhalation:

Inhalation of mist or splashes of iodine solution can cause severe irritation, with potential destruction of respiratory tissues, spasms, and edema (choking) in throat and lungs, depending on frequency and degree of exposure. Other reported potential effects are coughing, burning sensation, laryngitis, headache, and nausea.

Use a NIOSH approved respirator for liquid mists and/or splashes. Get supplier recommendations. Provide adequate ventilation. Avoid conditions that cause misting or splashing.

Remove to fresh air. Give artificial respiration and get medical attention as needed.

Skin:

May cause irritation with repeated exposure.

Wear water-resistant gloves as needed.

Wash exposed areas with soap and water for 15 minutes. Remove contaminated clothing, and wash before re-using.

Eyes:

Can cause irritation and potential eye damage with repeated exposure.

Wear splash-proof water resistant goggles. Have convenient eye-wash stations.

Flush with water for 15 minutes.

Ingestion

Can cause irritation of mouth, throat, and an upset stomach.

Wear a mouth cover or face shield when there is splashing.

Do not swallow. Rinse mouth. If swallowed, do not induce vomiting. Get prompt medical attention.

(No chronic effects reported)

IN ALL CASES: GET MEDICAL ATTENTION IF EFFECTS PERSIST.

Most likely routes of entry: skin, eyes, ingestion.

**SECTION 7 - PRECAUTIONS FOR SAFE HANDLING AND USE**

Spills and Leaks: Flush to sewer or ground with lots of water.

Storage and Handling: Keep containers closed, and do not heat over about 125°F. Discard any material that may be contaminated, or which otherwise may have changed composition. Use personal protection as described in Section 6.

Waste Disposal: In accordance with applicable regulations for liquid wastes. Is not a RCRA hazardous waste as of this date.

Empty Containers: Rinse. Disposal as appropriate for glass and plastic containers.

**SECTION 8 - REGULATORY INFORMATION**

DOT: Not regulated.,  
SARA Title III, S.313, Form R: Nothing reportable.

The information contained herein is based on data available at this time and is believed to be accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Since information contained herein may be applied under conditions beyond our control, and with which we may be unfamiliar, no responsibility is assumed for the results of its use. The person receiving this information shall make his own determination of the suitability of the material for his particular use.

AR307736





Appendix Q: OSHA Posters

1.0 OSHA Posters

- Federal OSHA
- Indiana OSHA
- Iowa OSHA
- Michigan OSHA
- Minnesota OSHA
- Oregon OSHA
- Wyoming OSHA

Copies attached.

2.0 OSHA Hearing Conservation Amendment

Copy attached.

# JOB SAFETY AND HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Provisions of the Act include the following:

## Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

## Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

## Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

## Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discriminatory action.

## Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

## More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, GA	(404) 347-3573
Boston, MA	(617) 565-7164
Chicago, IL	(312) 353-2220
Dallas, TX	(214) 767-4731
Denver, CO	(303) 844-3061
Kansas City, MO	(816) 426-5861
New York, NY	(212) 337-2378
Philadelphia, PA	(215) 596-1201
San Francisco, CA	(415) 744-6670
Seattle, WA	(206) 442-5930

To report suspected fire hazards, imminent danger safety and health hazards in the workplace, or other job safety and health emergencies, such as toxic waste in the workplace, call OSHA's 24-hour hotline: 1-800-321-OSHA.

## Proposed Penalty

The Act provides for mandatory civil penalties against employers of up to \$7,000 for each serious violation and for optional penalties of up to \$7,000 for each nonserious violation. Penalties of up to \$7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$70,000 for each such violation. A minimum penalty of \$5,000 may be imposed for each willful violation. A violation of posting requirements can bring a penalty of up to \$7,000.

There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to \$250,000 (or \$500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of \$10,000 or up to six months in jail or both.

## Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

## Consultation

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State Labor or Health department or a State university.

## Posting Instructions

Employers in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

*Lynn Martin*

Lynn Martin, Secretary of Labor

**U.S. Department of Labor**

Occupational Safety and Health Administration

Washington, DC  
1992 (Reprinted)  
OSHA 2203



This information will be made available to sensory impaired individuals upon request. Voice phone: (202) 523-8615; TDD message referral phone: 1-800-326-2577

U.S. GOVERNMENT PRINTING OFFICE : 1992 O - 320-782 OL 3

AR307739

# I O S H A

## SAFETY AND HEALTH PROTECTION ON THE JOB

AR307740

The intent of the Indiana Occupational Safety and Health Act of 1974, Indiana Code 22-8-1.1, is to assure, so far as possible, safe and healthful working conditions for the workers in the State.

The Indiana Department of Labor has primary responsibility for administering and enforcing the Act and the safety and health standards promulgated under its provisions.

Requirements of the Act include the following:

### EMPLOYERS:

Each employer shall establish and maintain conditions of work which are reasonably safe and healthful for employees and free from recognized hazards that are causing or likely to cause death or serious physical harm to employees. The Act further requires that employers comply with the Occupational Safety and Health Standards, Rules and Regulations.

### EMPLOYEES:

All employees shall comply with occupational safety and health standards and all rules, regulations, and orders issued under the Act which are applicable to their own actions and conduct.

### INSPECTION:

The Act requires that an opportunity be provided for employees and their representatives to bring possible safety and health violations to the attention of The Department of Labor Inspector in order to aid the inspection. This requirement may be fulfilled by allowing a representative of the employees and a representative of the employer to accompany the Inspector during inspection. Where there is no employee representative the Inspector shall consult with a reasonable number of employees.

### COMPLAINT:

Employees have the right to file a complaint with The Department of Labor. There shall be an inspection where reasonable grounds exist for The Department of Labor to believe there may be a hazard. Unless permission is given by the employees complaining to release their names, they will be withheld from the employer. Telephone Number: (317) 232-2693.

The Act provides that no employer shall discharge, suspend or otherwise discriminate in terms of conditions of employment against any employees for their failure or refusal to engage in unsafe practices or for filing a complaint, testifying or otherwise acting to exercise their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with The Department of Labor within 30 days of the alleged discrimination. Please note that extensions of the 30 day filing requirement may be granted under certain special circumstances, such as where the employer has concealed, or misled the employee regarding the grounds for discharge. However a grievance-arbitration proceeding which is pending would not be considered justification for an extension of the 30 day filing period. The Commissioner of Labor shall investigate said complaint and upon finding discrimination in violation of the Act, shall order the employer to provide necessary relief to the employees. This relief may include rehiring, reinstatement to the job with back pay and restoration of seniority.

All employees are also afforded protection from discrimination under the Federal Occupational Safety and Health Act and may file a complaint with the U.S. Secretary of Labor within 30 days of the alleged discrimination.

### VIOLATION NOTICE:

When an alleged violation of any provision of the Act has occurred, The Department of Labor shall promptly issue a written order to the employer, who shall be required to post it prominently at or near the place where the alleged violation occurred until it is made safe and required safeguards are provided, or 3 days whichever is longer.

### PROPOSED PENALTIES:

The Act provides for CIVIL penalties of not more than \$1,000 for each serious violation and for CIVIL penalties of up to \$1,000 for each non-serious violation. Any employer who fails to correct a violation within the prescribed abatement period may be assessed a CIVIL penalty of not more than \$1,000 for each day beyond the abatement date during which such violation continues. Also, any employer who knowingly or repeatedly violates the Act may be assessed CIVIL penalties of not more than \$10,000 for each violation.

### VOLUNTARY ACTIVITY:

The Act encourages efforts by labor and management, before The Department of Labor inspections, to reduce injuries and illnesses arising out of employment.

The Act encourages employers and employees to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries.

Such cooperative action would initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors.

The Act provides a consultation service to assist in voluntary compliance and give recommendations for the abatement of cited violations. This service is available upon a written request from the employer to the Bureau of Safety, Education and Training (BuSET). Telephone Number: (317) 232-2688.

### COVERAGE:

The Act does not cover those hired for domestic service in or about a private home and those covered by a federal agency. Those exempted from The Act's coverage include employees in maritime services, who are covered by U.S. Department of Labor, and employees in atomic energy activities who are covered by the Atomic Energy Commission.

### NOTE:

Under a plan approved March 6, 1974, by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), the State of Indiana is providing job safety and health protection for workers throughout the State. OSHA will monitor the operation of this plan to assure that continued approval is merited. Any person may make a complaint regarding the State administration of this plan directly to the OSHA Regional Office, Regional Administrator, Region V, U.S. Department of Labor, Occupational Safety and Health Administration, 230 South Dearborn Street, Chicago, Illinois 60604, Telephone Number: (312) 353-2220.

### MORE INFORMATION:

INDIANA DEPARTMENT OF LABOR  
402 West Washington Street, Room W195  
Indianapolis, Indiana 46204  
Telephone: (317) 232-2655

*Bennett J. Zeller*  
KENNETH J. ZELLER,  
Commissioner of Labor

**EMPLOYERS: This poster must be displayed prominently in the workplace.**



certified  
document

# SAFETY AND HEALTH PROTECTION ON THE JOB



Chapter 88-Code of Iowa provides job safety and health protection for workers throughout the State of Iowa.

The Iowa Division of Labor Services has the responsibility for administering this Chapter. The Division of Labor adopts Federal occupational safety and health standards as State of Iowa standards. Employers and employees are required to comply with these standards.

## **SAFETY ON THE JOB IS EVERYBODY'S RESPONSIBILITY!**

**EMPLOYERS:** Chapter 88 requires that all employers must furnish to employees employment and a place of employment free from recognized hazards which cause or are likely to cause death or serious physical harm to employees and comply with occupational safety and health standards adopted under this Chapter.

**EMPLOYEES:** Chapter 88 requires that each employee comply with occupational safety and health standards and all rules, regulations and orders issued pursuant to this Chapter which are applicable to the employee's own actions and conduct.

## **COMPLIANCE WITH SAFETY AND HEALTH REQUIREMENTS**

To ensure compliance with safety and health requirements, the Iowa Division of Labor conducts periodic inspections of places of employment. Inspections are conducted by trained compliance safety and health officers. Chapter 88 requires that an authorized representative of the employer and a representative authorized by the employees be given an opportunity to accompany the inspector for the purpose of aiding the inspection. Where there is no authorized employee representative, the compliance safety and health officers will consult with a reasonable number of employees concerning safety and health conditions in the workplace. Employees or their representatives have the right to notify the Division and request an inspection if they believe that unsafe and unhealthful conditions exist at their workplace. In addition, employees have the right to bring unsafe conditions to the attention of the compliance safety and health officer making the inspection. Complainant's names will be kept anonymous upon request.

Employees may not be discharged or discriminated against in any way for filing safety and health complaints or otherwise exercising their rights under Chapter 88. Employees who believe they have been discriminated against may file a complaint with the Division or the U. S. Department of Labor within 30 days of the alleged discrimination. Discrimination complaints of this nature by State or local governmental employees must be submitted to the Division of Labor Services.

If upon inspection the Division of Labor believes that Chapter 88 has been violated, a citation of alleged violations and proposed penalties will be issued promptly to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

Citations of violation issued by the Iowa Division of Labor must be prominently displayed at or near the place of violation.

Chapter 88 provides for mandatory penalties of up to \$7,000 for each serious violation and optional penalties of up to \$1,000 for each non-serious violation. Penalties of up to \$1,000 are required for each day during which an employer fails to correct a violation within the period set in the citation. Any employer who willfully or repeatedly violates Chapter 88 is to be assessed civil penalties of not more than \$70,000 for each violation.

Criminal penalties are also provided for in Chapter 88. A willful violation resulting in the death of an employee, upon conviction, is punishable by a fine of not more than \$10,000 or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

For assistance and information, including copies of Chapter 88 and of specific safety and health standards, contact:

**Iowa Division of Labor**  
1000 East Grand Avenue  
Des Moines, Iowa 50319-0209  
Telephone (515) 281-3606

## **COMPLAINTS ABOUT STATE PROGRAM ADMINISTRATION**

Any interested person or representative of such person or group of persons may submit a complaint to the Federal government concerning the operation or administration of any aspect of the Iowa Division of Labor's occupational safety and health activities pursuant to Chapter 88-Code of Iowa.

Complaints may be submitted orally or in writing to:

**Assistant Regional Administrator**  
U. S. Department of Labor  
Occupational Safety & Health Administration  
911 Walnut, Room 406  
Kansas City, Missouri 64106  
Phone: (816) 426-5861

Any such complaint should describe the grounds for the complaint and specify the aspect or aspects of the administration or operation of Iowa's program which is believed to be inadequate.

If upon receipt of the complaint, the Assistant Regional Administrator (ARA) determines that reasonable grounds exist to believe that an investigation should be made, the ARA shall cause such investigation, including any workplace inspection, to be made as soon as practicable.

If the Assistant Regional Administrator determines there are no reasonable grounds for an investigation of a complaint the ARA shall notify the complaining party in writing of such determination.

The Assistant Regional Administrator shall advise the complainant of the findings of any investigation conducted and any corrective action that may result.

The complainant's name and the names of other complainants shall not appear in any record published, released, or made available. The complainant's name will be deleted from any copy of the complaint which might be released or made available.

## **ISSUES NOT COVERED:**

The Iowa Division of Labor will not inspect any maritime operations, including bridge construction over border rivers. These operations will be under the jurisdiction of the Federal Occupational Safety and Health Administration. All complaints regarding maritime operations should be referred to the Federal Office listed above, except those involving State or local governmental employees which continue to be covered by the Iowa Division of Labor Services.

## **RIGHT-TO-KNOW**

The Iowa Hazardous Chemicals Risk Right-to-Know Law gives employees a right to information regarding hazardous chemicals in the workplace. Employers are to provide this information upon request.

*Allen J. Meier*  
Allen J. Meier, Commissioner  
Iowa Division of Labor Services

## **IMPORTANT!**

This poster must be displayed in a prominent place in the establishment to which the employees normally report to work.

# MICHIGAN SAFETY AND HEALTH PROTECTION ON THE JOB

THE MICHIGAN OCCUPATIONAL SAFETY AND HEALTH ACT, 1974 P.A. 154, AS AMENDED, REQUIRES POSTING OF THIS DOCUMENT IN A CENTRAL AND CONSPICUOUS LOCATION. FAILURE TO DO SO MAY RESULT IN A PENALTY.

The Michigan Occupational Safety and Health Act (MIOSHA)—Act No. 154 of the Public Acts of 1974, as amended—provides job safety and health protection for Michigan employees through the maintenance of safe and healthful working conditions. Under MIOSHA and a state plan approved in September, 1973 by the U.S. Department of Labor, the Michigan Departments of Labor and Public Health are responsible for administering the Act. Department representatives conduct jobsite inspections and investigations to insure compliance with the Act and with safety and health standards.

The contents of this poster describe many important provisions of the Act. These provisions apply equally to employers and employees in either private industry or the public sector.

## EMPLOYER REQUIREMENTS: MIOSHA requires that each employer:

1. Furnish to each employee employment and a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to the employee;
2. Comply with promulgated rules and standards and with orders issued pursuant to the Act;
3. Post this and other notices and use other appropriate means to keep his or her employees informed of their protection and obligations under the Act, including the provisions of applicable rules and standards;
4. Notify the Michigan Department of Labor within 48 hours of any fatality, or the hospitalization of 5 or more employees suffering injury or illness from the same incident. Notification may be accomplished by calling (517) 322-0333;
5. Make available to employees, for inspection and copying, all medical records and health data in the employer's possession pertaining to that employee;
6. Afford an employee an opportunity with or without compensation to attend all meetings between the Departments of Labor or Public Health and the employer relative to any appeal of a citation by the employer;
7. Give a representative of employees the opportunity to accompany the department during the inspection or investigation of a place of employment and to prohibit the suffering of any loss of wages or fringe benefits or discriminate against the representative of employees for time spent participating in the inspection, investigation, or opening and closing conferences;
8. Provide personal protective equipment, at the employer's expense, when it is specifically required by a MIOSHA standard to be provided at the employer's expense;
9. Not permit an employee, other than an employee whose presence is necessary to avoid, correct or remove an imminent danger, to operate equipment or engage in a process which has been tagged by the Department and which is the subject of an order issued by the Department identifying that an imminent danger exists;
10. To promptly notify an employee who was or is being exposed to toxic materials or harmful physical agents in concentrations or at levels which exceed those prescribed by a MIOSHA standard.

## EMPLOYEE REQUIREMENTS: MIOSHA requires that each employee:

1. Comply with promulgated rules and standards and with orders issued pursuant to the Act;
2. Not remove, displace, destroy, or carry off a safeguard furnished or provided for use in a place of employment, or interfere in any way with the use thereof by any other person.

**INSPECTIONS/INVESTIGATIONS:** Inspections and investigations are conducted by trained personnel. The Act requires that an employer representative and a representative of employees be given an opportunity to accompany the department representative for the purpose of aiding in the inspection or investigation.

If a representative of employees does not participate, the department representative will consult with a number of employees concerning matters of safety or health in the place of employment.

**COMPLAINTS:** Employees and employee representatives who believe that an unsafe or unhealthy condition exists in their workplace have the right to request an inspection by giving written notice to the Departments of Labor or Public Health. If a condition exists which may present an immediate danger, the Department should be notified in the most expedient manner without regard to a written notice. The names of complainants will be kept confidential and not revealed upon the request of the employee. Employees also have the right to bring unsafe or unhealthy conditions to the attention of the department representative during the conduct of an inspection or investigation.

The Act provides that employees may not be discharged or in any manner discriminated against for filing a complaint or exercising any of their rights under the Act. An employee who believes he or she has been discriminated against may file a complaint with the Michigan Department of Labor or the U.S. Department of Labor within 30 days of the alleged discrimination.

The U.S. Department of Labor is monitoring the operation of the Michigan occupational safety and health program to assure the effective administration of the state act. Any person may make a written complaint regarding the state administration of the state act directly to the Regional Office of OSHA, 230, South Dearborn, Chicago, Illinois 60604.

**CITATIONS:** If upon inspection or investigation the Departments of Labor or Public Health believe that a requirement of the Act has been violated, a citation alleging such violation and setting a time period for correction will be issued to the employer. The citation must be prominently posted at or near the place of alleged violation for three days or until the violation is corrected, whichever is later.

The Act provides for first instance penalties of up to \$7,000 for a violation. Penalties of up to \$7,000 per day may be assessed for failure to correct a violation within a proposed abatement period. Any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$70,000 for each such violation. Employers may appeal the alleged citation, the proposed penalties or the abatement periods to the Department and to the Board of Health and Safety Compliance and Appeals. Employees may appeal the abatement period in a similar manner. Employees also may appeal to the Board of Health and Safety Compliance and Appeals any decision issued by the Department in response to an employer appeal.

Criminal penalties also are provided for in the Act. A person who knowingly makes a false statement or report pursuant to the Act upon conviction is punishable by a fine of up to \$10,000 or may be imprisoned for not more than 6 months or both. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of up to \$10,000 or by imprisonment for not more than one year or both. A second conviction doubles the maximum monetary penalty and is punishable by imprisonment for up to three years.

## VOLUNTARY ACTIVITY AND COMPLIANCE

**ASSISTANCE:** The Act encourages employers and employees to reduce workplace hazards voluntarily.

The Michigan Departments of Labor and Public Health offer limited on-site consultation assistance to employers to assist them in achieving compliance with occupational safety and health standards. Training Specialists are available and can give advice on the correction of hazardous conditions and on the development of safety and health programs. Department staff are available to conduct seminars and training relative to occupational safety and health for both employer and employee groups. Requests for service should be addressed to the appropriate Department at the address shown below.

The U.S. Department of Labor will continue to enforce federal standards governing maritime operations of longshoring, shipbuilding, ship breaking and ship repairing. These issues are not covered by the Michigan Plan for Occupational Safety and Health.

## MORE INFORMATION:

Division of Occupational Health  
Department of Public Health  
3423 North Logan Street/  
Martin Luther King Jr. Boulevard  
P.O. Box 30195  
Lansing, Michigan 48909

Bureau of Safety and Regulation  
Department of Labor  
State Secondary Complex  
7150 Harris Drive, Box 30015  
Lansing, Michigan 48909

**THIS IS AN IMPORTANT DOCUMENT — DO NOT COVER!**

SET 2010 (792)

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# SAFETY AND HEALTH PROTECTION ON THE JOB

The Minnesota Occupational Safety and Health Act of 1973 provides for safety and health protection for workers throughout the State. The Act provides coverage for all public sector employees, except Federal, and all private sector employees except domestic and those under exclusive Federal jurisdiction.

The Department of Labor and Industry has the sole responsibility of administering the Act. The Department issues occupational safety and health standards, and its Occupational Safety and Health investigators conduct periodic inspections to ensure compliance with the Act.

The Employee Right-to-Know Act was passed by the 1983 Legislature with an effective date of January 1, 1984. That Act was incorporated as part of the Minnesota Occupational Safety and Health Act.

As part of the Minnesota Occupational Safety and Health Act, the Employee Right-to-Know Act applies to all Minnesota employers and employees with conditional exemptions for the following:

- 1) Small businesses (those with 20 or fewer full-time or equivalent full-time employees or not more than \$1,000,000 in annual gross revenues) are exempt from the hazardous substances and harmful physical agents provisions of the Act.
- 2) Small hospitals and clinics that qualify for the small-business exemption must still comply with the infectious agents provisions of the Act.
- 3) Waste service employers regulated under the Federal Resource Conservation and Recovery Act must develop and implement an approved training program for their employees.
- 4) Certain technically qualified individuals in a laboratory or a hospital or clinic who meet defined criteria are exempt from some of the provisions of the Act.

**EMPLOYERS:** Employers must furnish to their employees conditions and places of employment free from recognized hazards that are causing or are likely to cause death, serious injury or harm to the employees and comply with Occupational Safety and Health Standards issued by the Department of Labor and Industry.

Personal protective equipment, when required by the standards, must be made available by or at the cost of the employer.

Employers must evaluate their workplaces for the presence of hazardous substances and harmful physical agents and infectious agents in hospitals and clinics and provide employees who are routinely exposed to those substances or agents with prescribed training and information.

Written information on these hazardous substances, harmful physical agents, or infectious agents must be available in the workplace. Such information must be made accessible to employees or employee representatives within 24 hours of their request.

Containers of hazardous substances and equipment or work areas that generate harmful physical agents must be labeled.

**EMPLOYEES:** Employees shall comply with all occupational safety and health standards, rules, regulations, and orders issued under the Act that apply to their own actions and conduct on the job.

**TRAINING:** Training must be made available by, and at the cost of, the employer. Effective January 1, 1984, employees must be trained prior to initial assignment to a work area where they may be routinely exposed to a hazardous substance, harmful physical agent or infectious agent. Additional training must be provided whenever an additional hazardous substance, harmful physical agent or infectious agent is introduced in the workplace. Employees already working in an area of routine exposure to these substances or agents must receive training by July 1, 1984. Training updates must be provided at least annually.

**REFUSAL TO WORK:** An employee who reasonably believes that an assigned task poses an imminent danger of death or serious physical harm may refuse to work. If there is no reasonable alternative, the employee must, however, request the employer to correct the hazardous condition.

An employee who refuses in good faith to perform an assigned task will receive pay for that task. If the employee is not reassigned to other tasks by the employer, and the employee requests (within 24 hours) the Commissioner of Labor and Industry to inspect and determine the nature of the hazard, and the Commissioner determines that the employee would have been placed in imminent danger by performing the task.

An employee who refuses in good faith to work with a hazardous substance, harmful physical agent, or infectious agent because that employee has not been provided with required training or information and has not been reassigned to other tasks will receive pay for the task not performed if the employee requests (within 24 hours) the Commissioner of Labor and Industry to inspect and determine if a hazardous condition exists and the Commissioner determines that the employer failed to provide required training or information prior to the employee's assignment to the work area.

**COMPLAINTS:** Employees or their representatives have the right to file a complaint with the Department of Labor and Industry requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. The Department will withhold the names of employees filing a complaint upon request of those employees.

Employees shall not be discharged or discriminated against in any way for filing safety and health complaints or otherwise exercising any of their rights under the Act. Any employee who believes that he/she has been so discriminated against may file a complaint with the Department of Labor and Industry within 30 days of the alleged discrimination.

**INSPECTION:** The Act requires that a representative of the employer and an authorized representative of the employees be given an opportunity to accompany the Occupational Safety and Health investigator for the purpose of aiding the inspection.

The authorized employee representative, by participating in the inspection, shall not lose any privilege or payment that would have otherwise been earned.

The authorized employee representative shall be given the opportunity to participate in any conference of discussion held prior to or during any inspection.

Where there is no authorized employee representative available, the investigator shall consult with a reasonable number of employees concerning safety and health conditions in the workplace.

**CITATION:** If upon inspection the Department of Labor and Industry believes an employer has violated the Act, a citation alleging such violations will be issued to the employer with reasonable promptness. Each citation will specify a time period within which the alleged violation must be corrected.

The citation and proposed penalty issued to the employer must be posted immediately and prominently displayed at or near the place of the alleged violation for 15 days, or until it is corrected, whichever is later.

In the event that an investigator finds a condition or practice in any place of employment which presents substantial probability of a fatality or serious physical harm, the investigator shall, after consultation with the Commissioner, issue an order which prohibits such practices until corrected. The order shall remain in effect for a maximum of 72 hours.

**PROPOSED PENALTY:** The Act provides for mandatory penalties against employers of up to \$1,000 for each serious violation and for optional penalties of up to \$1,000 for each non-serious violation. Penalties of up to \$1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful or repeated violation may be punishable by a fine of not more than \$10,000 or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

**TRADE SECRETS:** The confidentiality of trade secrets is protected under the Act. Trade secret information concerning hazardous substances or mixtures may be registered by an employer or manufacturer with the Commissioner of Labor and Industry.

**COMPLAINTS ABOUT STATE PROGRAM:** Under a plan approved May 29, 1973 by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), the State of Minnesota is providing job safety and health protection for workers throughout the State. Although OSHA will monitor the operation of this plan to assure that continued approval is merited, any person may make a complaint regarding the state administration of the plan. Complaints regarding state administration of the plan should be sent directly to the Regional Office of OSHA located at 230 South Dearborn Street, Chicago, Illinois 60604. Phone: (312) 353-2220.

**VOLUNTARY COMPLIANCE:** The Department of Labor and Industry encourages employers and employees to reduce hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. Employers and employees may receive assistance in achieving voluntary compliance by contacting one of the OSHA Offices.

**CONSULTATION:** Free safety and health consultation services are available to private-sector employers on a priority basis. This service is independent of the OSHA enforcement activity. No citations or penalties are proposed in this cooperative approach to improve workplace safety. For information, contact the Consultation Division at (612) 297-2393.

**MORE INFORMATION:** For assistance or more detailed information, contact the nearest office of the Occupational Safety and Health Division:

Occupational Safety & Health Division  
415 N.E. Washington  
Brainerd, Minnesota 56401  
(218) 828-2455

Occupational Safety & Health Division  
108 Government Services Center  
320 West Second Street  
Duluth, Minnesota 55802  
(218) 723-4678

Occupational Safety & Health Division  
Government Center  
410 South Fifth Street  
Mankato, Minnesota 56001  
(507) 389-6501

Occupational Safety & Health Division  
Department of Labor and Industry  
444 Lafayette Road  
St. Paul, Minnesota 55101  
(612) 296-2116



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# JOB SAFETY & HEALTH

NR307744

## YOU HAVE A RIGHT TO

The Oregon Safe Employment Act of 1973 provides job safety and health protection for workers through the promotion of safe and healthful working conditions throughout the state. The Oregon Occupational Safety and Health Division (OR-OSHA) of the Department of Consumer and Business Services has the primary responsibility for administering the Act.

OR-OSHA issues occupational safety and health standards, and its trained safety and health compliance officers conduct job site inspections to ensure compliance with the Act. Requirements of the Act include the following:

**EMPLOYERS:** Must provide each of their employees a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to the employees; and must comply with occupational safety and health standards, rules, regulations, and orders issued under the Act.

**EMPLOYEES:** Must comply with all occupational safety and health standards, rules, regulations, and orders issued under the Act that apply to their own actions and conduct on the job.

**INSPECTION:** The Act requires that a representative of the employer and an authorized employee representative be given an opportunity to accompany an OR-OSHA compliance officer for the purpose of aiding an inspection.

Where there is no authorized employee representative, the OR-OSHA compliance officer must consult with a reasonable number of employees concerning workplace safety and health conditions.

**COMPLAINT:** Employees or their representatives who believe unsafe or unhealthy conditions exist in their workplace have the right to file a complaint with the nearest OR-OSHA office, requesting an inspection. OR-OSHA will withhold the names of complainants on request.

**CITATION:** If, upon inspection, OR-OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation(s) must be corrected.

The citation must be prominently displayed at or near the place of the alleged violation for three days, or until it is corrected, whichever is longer, to warn employees of dangers that may exist there.

**PROPOSED PENALTY:** The Act provides for mandatory penalties against employers of up to \$7,000 maximum for each serious violation, and for optional penalties of up to \$7,000 for each non-serious violation. Any employer who willfully or repeatedly violates the Act may be assessed civil penalties of up to \$70,000 for each such violation, and not less than \$5,000 for a willful violation. Any employer failing to correct violations within the proposed time period may be assessed a civil penalty of not more than \$7,000 per day per violation, until the violation is corrected. A civil penalty of up to \$1,000 will be assessed for violation of any posting requirement.

The Act also provides for criminal penalties. Any willful violation resulting in death of an employee, upon conviction is punishable by a fine of up to \$10,000 or by imprisonment for up to six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

**RIGHT TO KNOW:** You have the right under state law to all information about hazardous substances used in your workplace. For that information, contact your employer. If you have further questions about this, contact OR-OSHA.

### VOLUNTARY ACTIVITY:

While providing penalties for violations, the Act also encourages efforts by labor and management before an inspection to reduce injuries and illnesses arising out of employment. The department encourages employers and employees to reduce workplace hazards voluntarily, and to develop and improve safety and health programs in all workplaces and industries.

Such cooperative action should first focus on the identification and elimination of hazards that can cause death, injury, or illness to any employee. There are a number of public and private organizations that can provide information and assistance. OR-OSHA has a staff of trained safety and health professionals available to work with businesses in all industries to improve workplace safety and health. Consultations and training opportunities are available at no charge to Oregon businesses by calling 1-800-922-2689 (message only), or any OR-OSHA office listed below.

### MORE

**INFORMATION:** Additional information, copies of the Act, specific safety and health standards, and other applicable regulations are available from the following OR-OSHA offices:

Portland .....	229-5910
Salem .....	378-3274
Eugene .....	686-7562
Medford .....	776-6030
Bend .....	388-6066
Main Office (Salem) .....	378-3272

In compliance with the Americans with Disabilities Act (ADA), this publication is available in alternate formats by calling the OR-OSHA Public Relations Manager at (503) 378-3272 (V/TDD).

**DISCRIMINATION:** The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against have the right to file a complaint with the Oregon Bureau of Labor and Industries within 30 days after reasonable cause to believe discrimination has occurred. Employees may also file a civil action in the Oregon circuit courts. Private-sector employees also have the right to file a safety and health discrimination claim with federal OSHA. Your federal rights are independent of your Oregon rights, and any claim with federal OSHA must also be filed within 30 day of the alleged discrimination.

**CONCERNS:** Persons who have concerns regarding activities of the Oregon Occupational Safety and Health Division may report them to the Department of Consumer and Business Services, Oregon Occupational Safety and Health Division, Labor and Industries Bldg., 350 Winter St. NE, Salem, OR 97310, Phone: (503) 378-3272 (V/TDD).

### CASPA:

(Complaint against state program administration)

If you wish to register a complaint concerning the administration of the Oregon Safe Employment Act, contact U.S. Department of Labor, OSHA Region X 1111 Third Ave., Ste. 715 Seattle, WA 98101-3212.



Kerry Barnett, Director  
Department of Consumer & Business Services

# HEALTH AND SAFETY PROTECTION ON THE JOB

**THE WYOMING OCCUPATIONAL HEALTH AND SAFETY ACT** PROVIDES JOB HEALTH AND SAFETY PROTECTION FOR WORKERS EMPLOYED BY GENERAL BUSINESS AND INDUSTRY THROUGHOUT THE STATE AS WELL AS FOR ALL EMPLOYEES OF THE STATE AND ITS POLITICAL SUB-DIVISIONS. OCCUPATIONS WHICH ARE NOT AN ISSUE WITHIN THE STATE AND ARE NOT COVERED BY THE OCCUPATIONAL HEALTH AND SAFETY ACT INCLUDE SHIP REPAIRING, SHIP BUILDING, SHIP BREAKING AND LONGSHORING.

**WORKERS' SAFETY AND COMPENSATION (WSC)** IN CONSULTATION WITH THE **WYOMING OCCUPATIONAL HEALTH AND SAFETY COMMISSION**, CREATED BY THE ACT, HAS PRIMARY RESPONSIBILITY FOR ADMINISTERING THE ACT. WSC ISSUES RULES AND REGULATIONS FOR JOB HEALTH AND SAFETY PROMULGATED UNDER THE ACT.

**BY LAW: SAFETY ON THE JOB IS EVERYBODY'S RESPONSIBILITY!**

## **EMPLOYERS:**

EACH EMPLOYER SHALL FURNISH TO HIS EMPLOYEES, A PLACE OF EMPLOYMENT AND EMPLOYMENT WHICH ARE FREE FROM RECOGNIZED HAZARDS THAT ARE CAUSING OR THAT ARE LIKELY TO CAUSE DEATH OR SERIOUS PHYSICAL HARM.

EACH EMPLOYER SHALL COMPLY WITH OCCUPATIONAL SAFETY AND HEALTH STANDARDS, RULES, REGULATIONS AND ORDERS ISSUED PURSUANT TO THE ACT.

## **EMPLOYEES:**

EACH EMPLOYEE SHALL COMPLY WITH OCCUPATIONAL SAFETY AND HEALTH STANDARDS AND ALL RULES, REGULATIONS AND ORDERS ISSUED PURSUANT TO THIS ACT WHICH ARE APPLICABLE TO HIS OWN ACTION AND CONDUCT.

### **Inspection:**

THE ACT REQUIRES THAT A REPRESENTATIVE OR REPRESENTATIVES OF THE EMPLOYER AND A REPRESENTATIVE OR REPRESENTATIVES AUTHORIZED BY THE EMPLOYEES SHALL BE GIVEN AN OPPORTUNITY TO ACCOMPANY A DULY AUTHORIZED REPRESENTATIVE OF THE COMMISSION BEFORE OR DURING THE PHYSICAL INSPECTION OF ANY WORKPLACE FOR THE PURPOSE OF AIDING SUCH INSPECTION.

WHERE THERE IS NO AUTHORIZED EMPLOYEE REPRESENTATIVE, THE AUTHORIZED REPRESENTATIVE OF THE COMMISSION (COMPLIANCE OFFICER) SHALL CONSULT WITH A REASONABLE NUMBER OF EMPLOYEES CONCERNING MATTERS OF SAFETY AND HEALTH.

### **Violation:**

IF UPON INSPECTION WSC DETERMINES THAT AN EMPLOYER HAS VIOLATED THE ACT, A NOTICE OF VIOLATION WILL BE ISSUED TO THE EMPLOYER WITHIN 180 DAYS OF THE COMPLETION OF THE INSPECTION. EACH NOTICE OF VIOLATION WILL SPECIFY A TIME PERIOD WITHIN WHICH THE VIOLATION MUST BE CORRECTED.

THE NOTICE OF VIOLATION MUST BE PROMINENTLY POSTED IN A CONSPICUOUS PLACE AT OR NEAR THE SITE OF THE VIOLATION UNTIL THE VIOLATION IS CORRECTED, OR FOR 3 WORKING DAYS, WHICHEVER PERIOD IS LONGER.

### **Voluntary Action:**

TECHNICAL ASSISTANCE CONSULTATIVE SERVICES IS RESPONSIBLE FOR PROVIDING TECHNICAL ASSISTANCE TO ALL INDUSTRIES, BUSINESSES, EMPLOYEES, EMPLOYEE GROUPS, ASSOCIATIONS, STATE AND LOCAL GOVERNMENTS, ESTABLISHMENTS, AGENCIES AND DEPARTMENTS. THESE SERVICES ARE AVAILABLE UPON WRITTEN REQUEST FROM EMPLOYERS OR EMPLOYEES. THESE SERVICES INCLUDE BUT ARE NOT LIMITED TO COURTESY INSPECTIONS (WITHOUT ASSESSMENT OF PENALTIES), HEALTH AND SAFETY TRAINING AND CONSULTATIVE SERVICES.

### **Complaint:**

EMPLOYEES OR THEIR REPRESENTATIVES HAVE THE RIGHT TO FILE A COMPLAINT WITH WSC REQUESTING AN INSPECTION IF THEY BELIEVE UNSAFE OR UNHEALTHFUL CONDITIONS EXIST IN THEIR WORKPLACE. WSC WILL WITHHOLD NAMES OF EMPLOYEES COMPLAINING ON REQUEST.

THE ACT PROVIDES THAT EMPLOYEES MAY NOT BE DISCHARGED OR DISCRIMINATED AGAINST IN ANY WAY FOR FILING SAFETY AND HEALTH COMPLAINTS OR OTHERWISE EXERCISING THEIR RIGHTS UNDER THE ACT.

AN EMPLOYEE WHO BELIEVES HE HAS BEEN DISCRIMINATED AGAINST MAY FILE A COMPLAINT WITH WORKERS' SAFETY AND COMPENSATION, CHEYENNE, WYOMING 82002 AND/OR THE REGIONAL OFFICE OF OSHA, U.S. DEPARTMENT OF LABOR, AT THE ADDRESS LISTED AT THE BOTTOM OF THIS NOTICE WITHIN 30 DAYS OF THE ALLEGED DISCRIMINATION.

### **Penalty:**

THE ACT PROVIDES FOR MANDATORY PENALTIES OF UP TO \$7,000 FOR EACH SERIOUS VIOLATION AND FOR OPTIONAL PENALTIES OF UP TO \$7,000 FOR EACH NON-SERIOUS VIOLATION. PENALTIES OF UP TO \$7,000 ARE REQUIRED FOR EACH DAY DURING WHICH AN EMPLOYER FAILS TO CORRECT A VIOLATION BEYOND THE PERIOD SET FOR CORRECTION IN THE NOTICE OF VIOLATION. ALSO, ANY EMPLOYER WHO WILLFULLY AND KNOWINGLY VIOLATES THE ACT, UPON CONVICTION, IS TO BE ASSESSED PENALTIES OF NOT MORE THAN \$70,000 FOR EACH VIOLATION.

ADDITIONAL PENALTIES ARE ALSO PROVIDED FOR IN THE ACT. ANY WILLFUL VIOLATION RESULTING IN DEATH OF AN EMPLOYEE, UPON CONVICTION OF AN EMPLOYER, IS PUNISHABLE BY A FINE OF NOT MORE THAN \$10,000 OR BY IMPRISONMENT FOR NOT MORE THAN SIX MONTHS, OR BY BOTH. CONVICTION OF AN EMPLOYER AFTER A FIRST CONVICTION DOUBLES THESE MAXIMUM PENALTIES.

Note: Additional information may be obtained from Workers' Safety and Compensation, Cheyenne, WY 82002 (307) 777-7786.



THIS NOTICE SHALL BE CONSPICUOUSLY POSTED IN EACH PLACE OF EMPLOYMENT IN THE STATE OF WYOMING AS REQUIRED BY THE RULES OF PRACTICE AND PROCEDURE.

UNDER A PLAN APPROVED BY THE U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA), THE STATE OF WYOMING IS PROVIDING JOB SAFETY AND HEALTH PROTECTION FOR WORKERS THROUGHOUT THE STATE. OSHA WILL MONITOR THE OPERATION OF THIS PLAN TO ASSURE THAT CONTINUED APPROVAL IS MERITED.

ANY PERSON MAY MAKE A COMPLAINT REGARDING THE STATE ADMINISTRATION OF THIS PLAN DIRECTLY TO THE REGIONAL OFFICE OF OSHA, U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, 1999 BROADWAY #1690, DENVER, COLORADO 80202-5716, TELEPHONE (303) 391-5858.

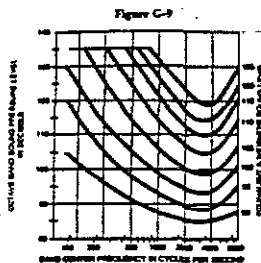


# OCCUPATIONAL NOISE EXPOSURE STANDARD AND HEARING CONSERVATION AMENDMENT

## Occupational Noise Standard

### 1910.95 Occupational noise exposure.

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:



A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table G-16.

(b)(1) When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

(2) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

TABLE G-16—PERMISSIBLE NOISE EXPOSURES

Duration per day, hours	Sound level, dBA time-weighted average
8	90
6	92
4	94
3	97
2	100
1 1/2	102
1	105
3/4	110
1/2 or less	115

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions:  $C_1/T_1 + C_2/T_2 + \dots + C_n/T_n$  exceeds unity, then, the noise exposure should be considered to exceed the limit value.  $C_n$  indicates the total time of exposure at a specified noise level, and  $T_n$  indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

## Hearing Conservation Amendment

(c) Hearing conservation program. (1) The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (e) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with Appendix A and Table G-16, and without regard to any attenuation provided by the use of personal protective equipment.

(2) For purposes of paragraphs (c) through (e) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

(d) Monitoring. (1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program. (2) The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(3) Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

(4)(i) All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

(ii) Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(3) Monitoring shall be repeated whenever change in production process, equipment or controls increases noise exposures to the extent that:

(i) Additional employees may be exposed at or above the action level; or

(ii) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (i) of this section.

(e) Employee notification. The employer shall notify each employee exposed to or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

(f) Observation of monitoring. The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

(g) Audiometric testing program. (1) The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

(2) The program shall be provided at no cost to employees.

(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintain-

ing and checking calibration and proper functioning of the audiometers being used. A technician who operates audiometric test equipment does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist, or physician.

(4) All audiograms obtained pursuant to this section shall meet the requirements of Appendix C: Audiometric Hearing Instruments.

(5) Baseline audiogram. (i) Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

(ii) Mobile test van exception. Where mobile test vans are used to meet the audiometric testing obligation, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wear hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

(iii) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

(iv) The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(6) Annual audiogram. At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

(7) Evaluation of audiogram. (i) Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift as defined in paragraph (g)(10) of this section has occurred. This comparison may be done by a technician.

(ii) If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram for that employee.

(iii) The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(A) A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (e) of this section;

(B) The baseline audiogram and most recent audiogram of the employee to be evaluated;

(C) Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: Audiometric Test Rooms.

(D) Records of audiometer calibrations required by paragraph (h)(5) of this section.

(E) Follow-up procedures. (i) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

(ii) Unless a physician determines that the standard threshold shift is not a medical or pathological condition, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

(A) Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

(B) Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(C) The employee shall be referred for a clinical audiometric evaluation or an otological examination, as appropriate. If additional pathology of the ear is caused or aggravated by the wearing of hearing protectors.

(D) The employee is informed of the need for an otological examination if a medical or pathological condition is unrelated to the use of hearing protectors is suspected.

(ii) If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 80 decibels indicates that a standard threshold shift is not persistent, the employer:

(A) Shall inform the employee of the new audiometric interpretation; and

(B) May discontinue the required use of hearing protectors for that employee.

(9) Retest exception. An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

(i) The standard threshold shift revealed by the audiogram is permanent; or

(ii) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

(10) Standard threshold shift. (i) As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

(ii) In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix E: Calculation and Application of Age Correction to Audiograms.

(b) Audiometric test requirements. (1) Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969.

(3) The test tones and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: Audiometric Hearing Instruments.

(4) Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: Audiometric Test Rooms.

(5) Audiometer calibration. (i) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

(ii) Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: Acoustic Calibration of Audiometers. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

(iii) An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2, 4.3, and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

(6) Hearing protectors. (i) Employees shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employee. Hearing protectors shall be replaced as necessary.

(2) Employees shall ensure that hearing protectors are worn.

(3) By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment, and

(4) By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

(A) Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(i); or

(B) Has experienced a standard threshold shift.

(5) Employees shall be given the opportunity to select their hearing protection from a variety of suitable hearing protectors provided by the employer.

(6) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(7) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

(8) Hearing protector attenuation. (i) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: Methods for Estimating the Adequacy of Hearing Protection Attenuation.

(ii) Hearing protectors must attenuate employee exposure to at least an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

(3) For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

(4) The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

(5) Training program. (i) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(ii) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work procedures.

(3) The employer shall ensure that each employee is informed of the following:

(i) The effects of noise on hearing;

(ii) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on correct fitting, use, and care; and

(iii) The purpose of audiometric testing, and an explanation of the test procedures.

(4) Access to information and training materials. (i) The employer shall make available to all employees a copy of the hearing conservation program and shall also post a copy in the workplace.

(2) The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

(4) Recordkeeping. (i) Exposure measurements. The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(2) Audiometric tests. (i) The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section.

(ii) This record shall include:

(A) Name and job classification of the employee;

(B) Date of the audiogram;

(C) The examiner's name;

(D) Date of the last acoustic or exhaustive calibration of the audiometer; and

(E) Employee's most recent noise exposure assessment.

(3) The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

(4) Record retention. The employer shall retain records required by paragraph (i) of this section for at least the following periods:

(i) Noise exposure measurement records shall be retained for two years.

(ii) Audiometric test records shall be retained for the duration of the affected employee's employment.

(4) Access to records. All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the Assistant Secretary. The provisions of 29 CFR 1910.20 (e) and (g) apply to access to records under this section.

(5) Transfer of records. If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (i) of this section.

(6) Appendices. (i) Appendices A, B, C, D, and E to this section are incorporated as part of this section and the contents of these Appendices are mandatory.

(2) Appendices F and G to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

(3) Examples. Paragraphs (c) through (i) of this section shall not apply to employers engaged in oil and gas well drilling and servicing operations.

(4) Startup date. Baseline audiograms required by paragraph (g) of this section shall be completed by March 1, 1994.

Additional information, as well as Appendix A-1 of the Amendment are available from the hearing conservation program administrator at this facility. For more complete information see 29 CFR 1910.95.

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*R/* Acronyms

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## Appendix R: Acronyms

### 1.0 Acronyms

Acronyms commonly used in the PHASP include:

AOC	-	Area of contamination
ELSA	-	Emergency Life Support Apparatus
IDLH	-	Immediately Dangerous to Life or Health
MSDS	-	Material Safety Data Sheet
MSHA	-	Mine Safety and Health Administration
NIOSH	-	National Institute for Occupational Safety and Health
OSHA	-	Occupational Safety and Health Administration
OVA	-	Organic Vapor Analyzer (Foxboro)
OVM	-	Organic Vapor Meter (Thermoenvironmental)
PEL	-	Permissible Exposure Limit (OSHA)
PHASP	-	Project Health and Safety Plan (Barr)
POTW	-	Publicly Owned Treatment Works
PPE	-	Personal Protective Equipment
PPM	-	Parts Per Million
REL	-	Recommended Exposure Limit
SA	-	Supplied Air
SCBA	-	Self Contained Breathing Apparatus
STEL	-	Short-Term Exposure Limit
TDU	-	Treatment/Disposal Unit
TLV	-	Threshold Limit Value (ACGIH)
TWA	-	Time Weighted Average
ACGIH	-	American Conference of Governmental Industrial Hygienists